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The Impact of an Osteopathic Medical Program on Information Technology Skills of Physicians Entering the Workforce

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The Impact of an Osteopathic Medical Program on Information Technology Skills of Physicians Entering the Workforce

by

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A dissertation submitted in partial fulfillment of the requirements
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in
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We hereby certify that this dissertation, submitted by Steve E. Bronsburg, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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2011

An Abstract of a Dissertation Submitted to Nova Southeastern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Increasingly, the health care field is utilizing information technology (IT) to help manage large volumes of medical data. This has created a need for health care workers to learn IT skills, which include information gathering skills (IGS), information analysis skills (IAS), and technology skills (TS). Research focused on medical students learning IT skills seems limited, while research focused on IT skills, age, and gender appear contradictory. Research suggests that physicians lack necessary health care industry specific IT skills.

The survey instrument used the three aforementioned skills (IGS, IAS, & TS), based on the Learning Skills Profile (LSP), to measure IT skill competency of both entering osteopathic medical students (group 1) and those who graduated medical school (group 2). Careful examination of both groups allowed for such comparison as they had similar gender distribution and Medical College Admission Test (MCAT) scores. A systematic way to measure student learning is to compare student competencies at the beginning and end of their education experience, while time permits, or ensure the two groups are as similar as possible in their demographic characteristics.

Data was collected from a sample of 430 students, 230 from Group 1, and 200 from group 2 at a private non-profit university in the southeastern United States. Data was analyzed from 102 participants who took the survey indicating a 24% response rate. Strong reliability was recorded for IGS, IAS, and TS with Cronbach's Alphas of .886, .934, and .937, respectively. Significant difference analysis was done using the non-parametric Mann Whitney U test and skills enhancements were plotted on star-graphs to demonstrate increases, if any, of the measured skills. Overall, IGS and IAS showed significant differences in skill enhancements, while TS did not demonstrate a significant skill enhancement between both groups. Additional attention should be given in current medical schools to enhance the TS of medical students, not just the enhancement of IGS and IAS. Gender testing resulted in a significant difference between the groups, while age did not. Limitations for the study were that both groups were surveyed during the same year from one osteopathic medical school. Future suggestions are presented.

Acknowledgements

Reflecting back on the doctoral courses I had, and the work it took to complete the dissertation, I am humbled by the quality of the faculty who taught me and the overall education I received from the Graduate School of Computer and Information Sciences at Nova Southeastern University. The courses challenged my abilities and helped me to become a better learner. I sincerely believe that the effort put forth by each of the faculty members who taught me was the key that allowed me to achieve my academic goals.

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I would be remiss if I did not thank my wife, Angela M. Bronsburg, for all of her support and understanding going through this process. Without her support this dissertation would not have been possible. As a language professor split between three campuses, while also pursuing in Italy a second masters in teaching Italian, she certainly endured her fair share of stress.

Table of Contents

List of Tables

Tables

List of Figures

Figures

Chapter 1

Introduction

Introduction

The American health care industry's growing use of information technology (IT) systems has helped to increase the volume and complexity of data used by medical doctors (Hersh, 2008). The American Medical Informatics Association (AMIA, 2008) recognized the need for the American health care workforce to learn IT skills to fully realize its benefits in the health industry. The physician plays a critical role in the American health care industry, helping to maximize resource investment through the use of IT. IT increases efficiency of information management, thus reducing medical errors (Hersh, 2008). Technology helps to improve the quality of health care, thus creating a need for medical students to learn IT skills and prepare them to enter the workforce as medical doctors (Romanov & Aarnio, 2006). Davidson and Heineke (2007) wrote that the health care industry has not seen the full impact of benefits that IT has to offer due to a lagging adoption and widespread use of it to manage medical data.

The AMIA (2008) had advocated teaching IT skills by setting a national goal of educating 10,000 health care informaticians by 2010, a goal that has not been achieved. This goal would create a minimum of one trained medical doctor and nurse for every hospital, nationally enabling successful implementation of health care IT as stated by the AMIA (2008). Medical education primarily focuses on science and research, which may

have limited opportunities, whereas medical informatics roles that utilize IT are on the rise (Hersh & Williamson, 2007). Prior IT skills of first year students continue to be an unknown variable despite published literature on this subject (Palaigeorgiou, Siozos, & Konstantakis, 2006).

Problem Statement

This research investigated the current issue of IT skills of first year osteopathic medical students (group 1) and those who are newly graduated osteopathic medical doctors entering the workforce (group 2). Research on the growth and use of IT in medicine by McGowan and Berner (2004), Gibson and Silverberg (2000), and Lynch, Whitley, Emmerling, and Brinn (2000) has demonstrated the need to teach medical students IT skills while in osteopathic medical school. Since osteopathic medical students are not learning IT skills as part of their medical education, the research problem that this study will address is the lack of attention on learning IT skills during the medical school experience. This study defined the osteopathic medical student as a full time degree-seeking individual attending the College of Osteopathic Medicine (COM) at Nova Southeastern University (NSU) in South Florida.

Hersh (2008) and Palaigeorgiou, Siozos, and Konstantakis (2006) stated that a universally accepted definition of IT skills has not been developed yet, despite earlier research by Romanov and Aarnio (2006) and Cullen and Litt (2002), who pointed to this issue. Still earlier research conducted by Bawden (2000) drew attention to defining and assessing IT skills because previous definitions often contradicted each other and gravitated toward industry specific competencies. The classic research conducted by Boyatzis and Kolb (1995) stated that skills are not only abilities, but also must consist of

a combination of ability, knowledge, and experience that directly relate to one's ability to complete a satisfactory task. Levy (2005) further defined learning IT skills as "the gain in transfer of knowledge (or information) and in applying such knowledge to a specific domain…learning skills refers to the difference in skill level before a treatment and after a treatment" (p. 4). This study will define IT skills as a combination of information gathering skills (IGS), information analysis skills (IAS), and technology skills (TS).

IT skills already identified in research include IGS, IAS, and TS, as well as the breakdown of baseline skills within each. Table 1 shows IT skills identified by the AMIA (2008), Hersh, (2008), Boyle and Strong (2006), McGowan and Berner (2004), Lang (2003), and the Association of College and Research Libraries (ACRL, 2000).

According to the AMIA (2008), new technologies and systems are being introduced into the work area continually; thus, preparing future generations to enter the workforce as fluent users of technology is a critical ongoing process. Working with an electronic medical record (EMR) is a real world example of how a physician uses IGS, IAS, and TS. A physician enters data into a computerized system creating an EMR. The data entered into the EMR is reviewed, matched against other data within the system, and converted into meaningful information, which can be analyzed further and used by the physician to make a knowledgeable decision based on evidence regarding the health care of a patient.

Levy (2005) defined IGS as "the ability to be sensitive to and aware of organizational events" (p. 6). Information analysis skills allow one to assimilate appropriate relevant data and information. Levy (2005) defined information analysis skills as the "ability to assimilate information from various sources" (p. 6). Alavi and

Table 1. IT Skills, Baseline Skills, and Supporting Literature

Information Technology Skills (IT Skills)	**Baseline Skills**	**Supporting Literature**
Information Gathering Skills (IGS)	Differentiate data vs. information, retrieve information using a variety of software and systems, use Web skills, gather qualitative and/or quantitative data	American Medical Informatics Association (2008), Hersh (2008), Boyle and Strong (2006), McGowan and Berner (2004), Lang (2003), and Association of College and Research Libraries (2000)
Information Analysis Skills (IAS)	Generate reports, recommend changes to strengthen the database system, use basic statistical analysis software, use health system data tools, choose appropriate system for tasks	American Medical Informatics Association (2008), Hersh (2008), Boyle and Strong (2006), McGowan and Berner (2004), Lang (2003), and Association of College and Research Libraries (2000)
Technology Skills (TS)	Enter and manipulate data, use physical and technical safeguards, resolve minor IT problems, understand basic IT concepts, use basic office software, use portable IT devices	American Medical Informatics Association (2008), Hersh (2008), Boyle and Strong (2006), McGowan and Berner (2004), Lang (2003), and Association of College and Research Libraries (2000)

Leidner (2001) indicated that gathering and analyzing information are critical IT skills. Levy (2005) defined technology skills as the "ability to use computers and computer networks to analyze data and organize information" (p. 6). Alavi and Leidner (2001) stated that one learns through processes, which are influenced by technology; thus, learning IT skills is significant to the learning process and preparing future users of technology.

Forman and Pomerantz (2006) investigated the medical education experience and the lack of attention given to learning IT skills. Gibson and Silverberg (2000) explained

that it is critical to incorporate the learning of IT skills throughout the medical school experience to prepare future doctors entering the workforce. This also would expose osteopathic medical students to use emerging technologies, ultimately preparing them for the future. They noted that IT affects every part of human life – communications, transportation, recreation and leisure activities, and health care. They further explained that similar to the microscope's impact on health care as an invaluable instrument, IT skills allow doctors to influence health outcomes profoundly on multiple levels, including how medicine will be delivered. However, despite efforts to integrate learning IT skills in medical education, not enough attention is given to developing them (Gibson & Silverberg, 2000). Gibson and Silverberg (2000) further declared that if physicians do not learn how to use IT, they will be at a disadvantage when practicing medicine, ultimately affecting the health care outcome of the patient.

Hassan (2006) explained that IT skills outcomes are the primary issue for information systems research, and must be examined continuously to determine if there are significant differences in the IT skills of medical students due to their medical school experience. Hassan (2006) stated that organizations, including those in the health care field, continue to seek ways to increase their efficiency by utilizing IT, yet they face the constant challenge of updating their employee IT skills. Limited IT skills reduce interest in expanding IT skills needed for success in the technology-oriented professional work environment (Smith, 2005). According to Hassan (2006), medical education has not spent enough time or attention on students learning IT skills, which are crucial to preparing newly graduated medical doctors entering the workforce. All medical students should have opportunities to learn IT skills throughout their medical education experience; yet

IT skills continue to be problematic for graduating osteopathic medical students (Hassan, 2006). According to McEuen (2001), medical students entering osteopathic medical schools have a limited scope of IT skills; this further highlights the need to understand what IT skills students possess so a baseline can be established. Similarly, McEuen (2001) noted that "Fluency in IT is comparable to fluency in writing…all students come to college knowing how to write, but many students aren't developed writers" (p. 16). McEuen (2001) explained further that the medical school experience lacks attention on IT skills, even though it is in a unique position to provide an opportunity to learn these skills.

Forman and Pomerantz (2006) stated that there is a current need to teach osteopathic medical students IT skills to enable them to utilize available technologies as well as emerging technologies constantly being introduced to the health care industry. Forman and Pomerantz investigated the IT skills of osteopathic medical students and found that they varied significantly, depending on the students' self-assessment of their IT competency. Their research seems to suggest that the IT skills of medical students need to be reviewed prior to entering osteopathic medical school so that academic experiences can be tailored to meet deficiencies in their IT skills. Schumacher (2002) reviewed literature between 1980 and 2000 that examined the growth of IT in health care and concluded that osteopathic medical students are seriously lacking IT skills. Schumacher felt that osteopathic medical students entered medical school with some IT skills, yet failed to further develop them or learn new IT skills throughout their medical education experience. Also, Schumacher stated that the demand in the medical field for workers with IT skills has increased dramatically due to advances in IT, creating a

current and future need for a technology savvy health care workforce. Schumacher further explained that "advances in technology can be thought of as reducing the cost of capital…if capital and labor are complements…then any increase in technology will increase the need for skilled labor" (p. 401). A prior needs assessment by Hersh, Junium, Malhot, and Tidmarsh (2001) indicated that physicians in the field felt that they were lacking in IT skills and had a strong desire to learn them.

The recognition of the importance of IT skills was well-documented by medical school accreditation agencies, which include the Commission on Colleges of the Southern Association of Colleges and Schools (SACS, 2004) and the American Osteopathic Association's Commission on Osteopathic Colleges Accreditation (AOA, 2004), as well as earlier work done by the Association of American Medical Colleges (AAMC, 1998), which has placed strict guidelines on medical school education by outlining the development of new IT skills. The American Medical Association (AMA, 2005) identified general gaps in physician preparation, including the management of information. According to the AMA, many doctors are not prepared to use IT to assist in gathering and analyzing data. It appears that additional research is warranted to investigate the IT skills of osteopathic medical students and how the academic experience affects these skills.

Smith (2005) stated that IT skills are critical and that all students need an IT enriched academic experience to prepare them to enter the workforce as competent medical doctors. Smith examined gender differences in learning IT skills and found differences in postsecondary as well as secondary education levels. She noted that women had more IT skills anxiety and received less encouragement than men. Knight

and Pearson (2005) conducted IT skills research with age and gender constructs, and drew conclusions contradictory to Smith. Knight and Pearson (2005) concluded that age and gender made no difference in IT skills, although women did experience more anxiety than men, which negatively affected their learning of IT skills. It therefore appears that demographic variables such as age and gender might have an effect on osteopathic medical students learning IT skills, warranting further investigation.

Goals

The main research question that this study addressed was: What role do the osteopathic medical school experience and the information on demographics have on learning IT skills? Osteopathic medical students' IGS, IAS, and TS were analyzed to determine if there were significant differences on how the medical school experience affected learning IT skills. Schumacher (2002) explained that the increased use of IT has created a demand for an IT competent medical workforce. Staggers, Gassert, and Skiba (2000) also stated that the inclusion of IT skills education in the health profession fields has been slow at best.

Additionally, the study addressed four specific research questions as follows. The first specific research question (RQ1) was: What role does the osteopathic medical school experience have on learning IGS for students entering medical school and for those who are graduating? The second specific research question (RQ2) was: What role does the osteopathic medical school experience have on learning IAS for students entering medical school and for those who are graduating? The third specific research question (RQ3) was: What role does the osteopathic medical school experience have on learning TS for students entering medical school and for those who are graduating? The fourth

specific research question (RQ4) was: Are there significant differences among the three IT skills (information gathering, information analysis, and technology) between students entering osteopathic medical school and those who are graduating, based on their age and gender?

A two-year study by Gibson and Silverberg (2000) with first year medical students using skills-based cohorts identified that there was reluctance to include learning IT skills in medical schools, including osteopathic medical schools, because it was inferred that medical students will learn IT skills on their own. This research utilized a survey instrument to gather measurable data on learning IT skills, as well as demographic information, from osteopathic medical students entering their first year of study and from those who recently graduated and were entering the workforce. The results have produced raw data that was cleaned and analyzed. This information was used to determine if there were significant differences in osteopathic medical students learning IT skills in medical school. The need for this work was clearly demonstrated through the findings of McGowan and Berner (2004), Gibson and Silverberg (2000), and Lynch et al. (2000), whose research points out that all medical students are not ready to use computerized testing such as the United States Medical Licensing Exam (USMLE). Lynch et al. (2000) stated that learning IT skills are necessary to prepare medical students for computer based testing. Lynch et al. noted that osteopathic medical students lack IT skills, regardless of age or gender.

A study conducted by Talja (2005) found that learning IT skills continues to be an ongoing necessary component of the medical school experience as it builds a foundation one can rely upon to learn emerging technologies. Lynch et al. (2000), as well as Gibson

and Silverberg (2000), stated earlier that medical professionals need to learn IT skills because health care increasingly is using technology; thus, medical students must be well prepared to enter the workforce as competent users of IT. A later study by Cartwright, Korsen, and Lynn (2002) confirmed the Gibson and Silverberg (2000) survey results, which indicated technical skills, gathering information skills, and analyzing information skills are critical for physicians.

Relevance and Significance

As stated in the problem statement, this research investigated the current issue of IT skills of osteopathic medical students. The primary focus was to study what role, if any, that the medical school experience, age, and gender had on medical students learning IT skills. The second focus of this study was to learn more about the IT skills of students who are entering medical school and those who are graduating and entering the health care workforce. Lium, Laerum, and Schulz (2006) surveyed physicians whose data suggested that a lack of IT skills still exists in the medical industry. Lium et al. (2006) stated that there is a critical need for the medical industry to adopt IT skills in order to be prepared for emerging technologies such as EMRs, telemedicine, computerized provider order entry systems, or practice management systems. Ford, Menachemi, and Phillips (2006) stated that "on April 22, 2004, President Bush issued an executive order to implement EMRs nationwide, within ten years" (p. 106). The current administration also has allocated resources for EMRs. Ford et al. (2006) further stated that the medical education industry's lack of effort to develop IT skills for their students and residency programs has hampered the preparation of future physicians to use EMRs and other health care related technologies.

According to Hersh (2002), the medical school experience not only should consist of a traditional medical education focusing on science, but also on a mastery of the management of information systems and information technologies. Hersh also stated that health care and medicine are based on IT linking to industry, which will enable a significant positive difference in overall health care outcomes. Hersh concluded that opportunities for osteopathic medical students to learn IT skills will lead to confidence in dealing with the emerging fields of medical informatics and biomedical informatics, which rely heavily on IT skills, effectively preparing medical students to enter the workforce as competent medical doctors. Cartwright et al. (2002) stated that IT skills are crucial for health care providers because technology is being utilized increasingly in medicine to manage large amounts of information and data as well as information systems with great success. Physicians constantly are introduced to new and cutting edge technology, which aids in their management and delivery of health care. Arons (2001) explained that IT skills are crucial for the advancement of health care research, allowing doctors to gather and analyze large amounts of data and enabling them to choose the best course of action to promote health, reduce suffering, and cure illness. Masiello, Ramberg, and Lonka (2005) stated that increased use of IT has changed how doctors work; thus, educators must utilize these advances and prepare all medical students to learn IT skills.

Riley, Adelman, Algan, and Campanella (2000) explained that a pervasive utilization of technology in health care has placed learning demands on those in the field to catch up; thus, a positive relationship in health care outcomes seems to be placed on learning IT skills during the medical school experience. Riley et al. (2000) conducted a study of core skills, including IT skills, at 19 osteopathic medical schools and concluded

that the key areas of study lacking included IGS, IAS, and TS. Riley et al. (2000) stated that learning IT skills is of great value while in medical school and is crucial to preparing future medical doctors. Bell, Daly, and Robinson (2003) supported Riley et al. (2000), stating the importance of learning IT skills while in school. Bell et al. (2003) suggested that with the increased use of IT as a tool in medicine, doctors need to have a competent set of IT skills. Bell et al. (2003) further elaborated that learning IT skills during the medical school experience should help prepare students to enter the workforce and adapt to existing and new technologies confidently. Bell at al. (2003) pointed out that even though attitudes towards IT skills were equal in their research, there is a digital divide in the medical industry. This divide is not between those who have access and those who do not, but rather between those who utilize IT and those who do not. Bell et al. (2003) reviewed specific areas of the population, such as underserved and rural areas, that have access to technology, yet IT utilization levels were low. According to Bell et al. (2003) more research is warranted to determine the dynamics of how all medical students should learn IT skills to prepare them to enter the health care workforce.

Jerant and Lloyd (2000) analyzed the IT skills of first year medical students and residents, as well as medical faculty at the University of California, Davis (UCD). Jerant and Lloyd's findings showed that medical schools do not pay enough attention to students learning IT skills or to upgrading their faculty's IT skills. Yen, Chen, Lee, and Koh's (2003) findings were consistent with the earlier work of Jerant and Lloyd (2000). Yen et al. (2003), who surveyed 15 universities in Taiwan, reporting from their findings that medical students need to learn IT skills during the medical school experience to prepare them to take advantage of the emerging IT applied to the medical field. Vincent,

Meche, and Ross (2002) stressed the importance of students keeping up with evolving IT skills as they seek degrees in higher education. Riegelman and Persily (2001) explained that contemporary medical practice utilizes the latest technology to stay competitive within the industry and to advance the efficiency of health care. Thus, the medical school experience must prepare future medical doctors properly for emerging technologies. Riegelman and Persily (2001) also stated that this technology will challenge what presently is being taught and how it is taught.

Gibson and Silverberg (2000) stated that IT skills are critical for mastering emerging technologies utilized in health care today, yet the medical school experience has been slow to incorporate such skills. According to Schumacher (2002), technology allows physicians to become more efficient and take on more responsibility, thus creating a demand industry wide for these skills. Talja (2005) further explained that "IT competencies is a dialogic social construct tied to technical knowledge…rarely taken under scrutiny in discussions of IT literacy yet has profound implications for the aims and methods in teaching IT skills" (p. 13). Garde, Harrison, Huque, and Hovenga (2006) studied the IT skills of health professionals and reported on the industry's strain to keep its workforce current on new promising technologies entering the medical field. Staggers, Gassert, and Curran (2002) and Chen (2005) did separate research on the IT skills of health professionals and concluded that adapting IGS, IAS, and TS were highly sought after and desirable in the medical industry. Talja (2005) explained that measuring IT skills rarely is taken into consideration, yet is critical to learning IT skills. Thus, establishing a benchmark is important.

Barriers and Issues

Physician information management skills are a critical set of IT skills that cannot be overlooked, yet medical education seems to lag in the adoption of learning IT skills necessary to manage information (Chumley, Dobbie, & Delzell, 2006). Medical schools seem not to prepare medical students to learn IT skills; thus there remains a need to reengineer the health education of future medical doctors as well as the overall health care system (Hersh, 2004). The limited use of IT by the workforce in the health care industry, coupled with the increased volume of data that a physician must work with, has created a need to keep up constantly with current and emerging technologies. Physicians must retrieve data and review it in a manner that produces accurate information, enabling them to make effective evidence based decisions. This process is known as evidence based medicine (EBM), which is anchored in the health care industry in the area of standards of care, which ultimately affects all health care decisions.

Understanding the level of IT adoption of the osteopathic medical school administration and faculty was a considerable issue that added a level of complexity to this survey. This affected how both the administration and the faculty viewed the study. Some faculty members who use cell phones or personal digital assistants such as a Blackberry and who sync data into their computer on a daily basis found the study as having some value. Faculty who use technology devices regularly encouraged the medical students to expand their learning of IT skills. However, there are certain medical school professors who are not IT savvy and they viewed the study as an exercise of little value. Some faculty and administrators misguidedly feel that being able to use the Web to find information for a research paper is being IT savvy. These beliefs were important for

the survey of newly graduating medical doctors entering the workforce, because they were exposed to the faculty and their bias, while those starting medical school were not.

The goal of this study was to bring about a clearer conceptualization of what IT skills may be learned or enhanced during the medical school experience. Davidson and Heineke (2007) stated that there still are skeptics in the health care industry regarding technology's benefits; thus they proposed studying IT's promised benefits and how to develop the IT skills to achieve these benefits. Many osteopathic medical school academics harbor skeptic attitudes towards the benefits of IT. This study investigated osteopathic medical students and newly graduated osteopathic medical doctors entering the workforce and the IT skills they utilized. The survey instrument investigated medical students' appropriate use of IT skills, which brought about meaningful raw data and information. Hersh (2002) discussed the issue of the medical industry's concern about the inefficient utilization of information and the lack of IT skills training of medical students, which negatively affects medical doctors' timely utilization of information.

Osteopathic medical students carry a heavy academic load while in school, and there is additional pressure on them to volunteer time and effort in the community. Therefore, it was difficult to get them to fill out a survey that was not mandatory or part of their curriculum. However, announcing the survey at the Dean's hour gave it a sense of importance and acceptance by medical faculty and the administration. In addition, having the voluntary survey online made it easier to access and complete.

Limitations and Delimitations

Limitations

This study used a Web-based survey instrument targeting first year medical students (group 1) and newly graduated osteopathic medical students entering the workforce (group 2) from one osteopathic medical school located in the southern part of the United States. The scope of the survey was limited to medical students and to one osteopathic medical school. It is anticipated that the survey could be duplicated at other osteopathic medical schools as well as at allopathic medical schools nationally and internationally.

Administration and access of the survey offered several challenges, including how to notify students and ask them to participate in a voluntary survey, when to post the survey, and how long the survey would be available for students to access.

The short survey instrument was posted on the Web, allowing the two targeted groups easy access. Posting the survey on the Web was critical for both groups to access and respond quickly and conveniently. Access to the survey was available on the Web only, and was administered to group 1 at the start of the academic year and to group 2 during graduation week during the same academic year. Offering the survey instrument on the Web to both groups at the start of the academic year and then at the time of graduation made it convenient to access and complete.

The decision on when to open and close the survey to group 1 was made so as not to interfere with their academic work. Once first year medical students start classes, their time is absorbed by academic demands, with hard deadlines taking priority. Therefore, the survey instrument was posted prior to the first year osteopathic medical student

orientation. An email was sent to group 1, asking them to participate in a voluntary survey and providing a link to access it. The survey also was announced during the Dean's hour for the new medical students. The survey was available for 21 days. It was important to have students complete the survey before they got too busy with academic work. A similar email was sent to group 2, with the same 21 day access. However, in the case of this group, there was a shorter window of opportunity to get them to complete the survey. Once medical students graduate and become medical doctors, within weeks they start their residencies, which are time consuming and take priority.

Another concerning issue was that the survey was voluntary. An osteopathic medical student's workload is full, and leaves little or no time for anything but school work. On the surface, it would seem that first year osteopathic medical students might have more time in their academic schedules to participate in the survey, while the osteopathic medical doctors who just graduated from medical school and are entering the workforce might have very little or no free time available due to their new positions as residents. The time constraint issues with both groups may be the reason why research seems limited in this area, although both groups responded to the survey instrument in this study.

Another issue was that the survey was administered to two different groups during the same academic school year. Determining how IT skills may differ before starting osteopathic medical school and whether IT skills are affected by the medical school experience was the ongoing theme of this research. Both groups will have met the prerequisite course requirements to enter osteopathic medical school, and both groups had similar Medical College Admission Test (MCAT) scores as well as a consistent

gender distribution over the past four years. To reduce the issue of a possible low response rate, demographic information such as age and gender were collected to ensure the sample was a good representation of the population.

Delimitations

Preliminary discussions with the COM administration at NSU were positive toward research activities that would involve medical students since this potentially could provide them with a better understanding of their medical students' IT skills. This response is a delimitation of the study as it may not be the same at other osteopathic or allopathic medical schools.

Definition of Terms

The following list of terms and definitions is provided to clarify key concepts of this study.

Doctor of Osteopathy

According to the NSU Health Professions Division (HPD) COM Catalog (2010-2011), academically "A doctor of osteopathic medicine (D.O.) is trained in all aspects of patient care… D.O.s offer a distinct holistic approach to medicine…an emphasis on primary care, by using osteopathic manipulative medicine when necessary" (p. 23).

Information

Shortliffe and Cimino (2006) define information as "organized data or knowledge that provides a basis for decision making" (p. 984).

Information Analysis Skills

Levy (2005) explains information analysis skills as "the ability to assimilate information from various sources" (p. 6).

Information Gathering Skills

Levy (2005) defines information gathering skills as "the ability to be sensitive to and aware of organizational events" (p. 6).

Information Technology Skills

This study defines IT skills as a combination of information gathering skills (IGS), information analysis skills (IAS), and technology skills (TS).

Learning

According to Mainemeilis, Boyatzis, and Kolb (2002), the definition of learning is the combined process of grasping and transforming: "grasping consists of concrete experience and abstract conceptualization…transforming consists of reflective observation and active experimentation…individual learning styles are determined by individual's preferred way of resolving these two dialectics" (p. 5).

Learning Skills

Levy (2005) defines learning skills as "the gain in transfer of knowledge (or information) and applying such knowledge (or information) to a specific domain (i.e. practice)" (p. 4).

Learning Skills Profile

Boyatzis and Kolb (1991) conducted classic work with the Learning Skills Profile and define it as "a 72-item modified Q-sort assessment instrument designed to assess learning skills" (p. 279).

Osteopathic Medical Student

For the purposes of this study, an osteopathic medical student is a full time degree-seeking individual accepted into the College of Osteopathic Medicine at Nova

Southeastern University.

Physician

Physician refers to an osteopathic medical doctor (D.O.) or allopathic medical doctor (M.D.); both are licensed to practice medicine (NSU HPD COM Catalog, 2010-2011).

Skill

According to Boyatzis and Kolb (1991) skill is defined as "a combination of ability, knowledge and experience enabling a person to do something well" (p. 280).

Technology Skills

This study will use the definition of technology skills as defined by Levy (2005) as "the ability to use computers and computer networks to analyze data and organize information" (p. 6).

Summary

Chapter 1 is an introduction to osteopathic medical students and their IT skills as reviewed in a current literature search, as well as an outline of the study. Osteopathic medical students start medical school with some IT skills, which may include those that will help them manage information. Medical students need to learn IT skills in order to manage increasingly vast amounts of information. A literature search of referenced journal articles suggests that medical schools are utilizing technology throughout the medical school experience, although there is conflicting literature suggesting medical students lack IT skills. Medical students may have a basic comprehension of IT skills similar to their development of basic writing skills, both of which improve over time with practice and use. There seems to be limited, if any, information on whether osteopathic

medical students learn or enhance their IT skills while going through the medical school experience. This confusion on what IT skills a medical student may have also is one of the underlining issues of this study.

Faculty and administration are crucial to an osteopathic medical student's successful completion of medical school. Medical students who are encouraged by faculty who foster or mentor them to embrace learning IT skills will develop and enhance these skills throughout their lives, enabling them to adapt to new and existing technologies used to manage information in the health care field. In medical school, however, many administrators and faculty still feel that medical students can learn IT skills on their own. Many medical schools have no idea what IT skills their students possess when they arrive at school or what they may have learned throughout their medical school experience.

The study used the Learning Skills Profiles (LSP), a pre-existing survey instrument modified to query the IT skills of both groups. This information will bring about a better understanding of the IT skills of osteopathic medical students before they begin medical school as well as analyze those who have gone through the didactic portion of medical school. The results should be meaningful in bringing about a better understanding of the IT skills of osteopathic medical students and whether there are gaps in IT skills that need to be addressed to prepare future osteopathic medical doctors to enter the workforce.

Chapter 2 of this dissertation reviews the literature on medical students and learning IT skills. The literature review was focused on the major concepts of the study of IGS, IAS and TS, as well as the role that age and gender may have on learning IT skills.

Chapter 2

Review of the Literature

Introduction

This chapter contains a review of the literature that relates to osteopathic medical students learning IT skills. There are several components that serve as theoretical foundations for this research, which include learning and IT; IGS, IAS, and TS; and the role that age and gender may have on learning IT skills. These topics were presented and explored in a manner that examined their relevance to the research.

The first key concept that this study presented was learning and IT. The discussion that follows reviews current and prior key research that has established a fundamental understanding of learning with a focus on IT skills. The next three concepts of IGS, IAS, and TS are discussed in a manner that reveals their critical role as skills that osteopathic medical students as well as medical doctors need to develop. A review of the literature focusing on age and gender and its relationship to IT skills is presented as well.

Learning and Information Technology

Similar studies measuring the IT skills of students were used to help construct this study. Levy (2005) conducted research that studied traditional full-time, on-campus students as well as part-time students who took online classes; both groups of students

were in the Masters of Business Administration (MBA) Program. Mainemelis et al. (2002) conducted similar research and found similar results, which stated that students who work with technology regularly, such as taking online courses, showed an increase in their abilities to learn IT skills. Mainemelis et al. (2002) focused their study on individual courses within an MBA program on campus, while Levy (2005) reviewed both the on-campus and online MBA programs. Levy (2005) felt that reviewing both programs would allow for the collection of data that could be compared and analyzed, bringing more insight into how students learn. This study took a similar approach in that it reviewed the entire medical school academic experience, from those entering their first year of osteopathic medical school (group 1) to those who graduated the program during the same year (group 2), rather than focusing on individual classes or a series of courses. It is anticipated that this method will enable more meaningful data analysis and bring a deeper understanding and knowledge to the subject matter.

Levy (2005) measured business skills using the LSP as a pre-test and post-test for both full-time MBA students on campus and online MBA students. Both groups of students showed marked improvements in their managerial skills, while the online students showed a noticeable improvement in their overall skills. Contrasting the study by Levy (2005), Mainemelis et al. (2002) focused on learning styles and adaptive flexibility with MBA students in full-time and part-time programs using the Learning Style Inventory (LSI), the Adaptive Style Inventory (ASI), and the LSP to gather data. They examined MBA students' IGS, IAS, and TS as well as behavior skills to determine learning styles. Results of Mainemelis et al. (2002) showed that IAS needed to be emphasized in the academic curriculum. However, since only MBA students were used in

the study, this may have been a limiting factor and may affect the study's overall generalizability. This study used the LSP as the basis for the survey instrument and reviewed IT skills, which is what the LSP assesses. Mainemelis et al. (2002) support assimilating IT skills into the educational experience to help students learn IT skills, which is consistent with the recommendations of the AMA (2005), the AMIA (2008), and the ACRL (2000). According to Mainemelis et al. (2002), conceptualization and experience allow for adaptive learning through higher levels of analytic skill. Medical students who have integrated learning IT skills through conceptualization and experience will have positioned themselves to respond effectively and adapt to learning new IT skills throughout their academic career. IT in the medical industry continues to expand in use, and there is a push for national EMR, which requires the entire health care industry to utilize this technology. Mainemelis et al. (2002) have demonstrated that students must be exposed to learning a variety of skills during the academic experience in order to develop the ability to adapt to the rapidly changing demands of the work environment. Further research in this area is needed to better understand how exposure to learning new skills prepares one to adapt to future demands. This is significant because the IT skills of medical students need to be evaluated to determine if any gaps exist, prohibiting them from assimilating past experience and skills and adapting to new and emerging technologies.

Boyatzis and Kolb (1995) performed important key research in the area of learning and skills. They describe four different phases related to one's learning from previous experience. The four phases are concrete experience, reflective observation, abstract conceptualization, and active experimentation. These phases can be linked to

IGS, IAS, and TS. Concrete experience is what someone learns through doing. Utilizing IT on a daily basis builds experience and confidence. Reflective observation is direct learning through observation. Abstract conceptualization is the ability to pull together experiences and observations and apply them to an issue that is unrelated to both. This can be associated with working with a new piece of medical software and using gathering and analyzing skills. Active experimentation is learning through trial and error.

Boyatzis and Kolb (1995) researched learning and skills to get a better understanding of skill, which enables them to measure skills as they relate to learning: "A skill is a combination of ability, knowledge, and experience that enables a person to do something well...a learning skill enables mastery of a specific domain" (p. 2). Accordingly, skills have three important points: they are domain specific and knowledge rich, they describe an integrated transaction between the person and the environment, and they are developed and mastered by practice (Boyatzis & Kolb, 1995). Similarly, the AMIA (2008) had established medical student competencies to improve the medical academic curriculum, which included learning IT skills such as IGS and IAS. The AMIA (2008) used Bloom's Taxonomy to categorize IT skills into cognitive knowledge, affective behavior or attitude, or psychomotor skill. Bloom's Taxonomy states that if one is trained or somehow educated in some particular area, then they will acquire new or expanded existing knowledge and learning therefore will have occurred. Boyatzis and Kolb (1995) reflect Bloom's earlier work on learning, though they do not look at attitude as a key component. Their research is supportive of the major higher education and medical education groups (AMA, AMIA, and ACRL), which suggest medical students need to be exposed to learning IT skills while in medical school.

The focus of this study is on learning IT skills specifically. Bloom's Taxonomy does review learning, but also includes attitude, which is beyond the scope of this study. The LSP is a generalized measure that includes learning business skills as well as IT skills. The LSP components that measure learning IT skills were relevant to this study and were the focus of the survey instrument. The LSP assesses learning skills, which are situational and specific with intentional development of skills (Boyatzis & Kolb, 1991). The three key components outlined by Boyatzis and Kolb (1991) stated that skills are domain specific and knowledge rich, skills describe an intricate action between the person and the environment, and skills are developed by practice. According to Boyatzis and Kolb (1991), skills used to transfer knowledge are ability, knowledge, and experience. The LSP focuses on skills and consists of 12, 6-item instruments administered in a modified Q-sort format. Within the broad scope of the LSP instrument, there are three critical skill areas: IGS, IAS, and TS, which are the foundation of this study, with the LSP as the core of the survey instrument to gather data.

Earlier work that influenced the structure of this study was conducted by Boyatzis and Renio (1989) at the Weatherhead School of Management (WSOM) where they assessed the skills of part-time and full-time MBA students entering the program and those who were about to graduate. They analyzed students' skills and abilities to determine if they had improved by the time they had finished the MBA program at WSOM. While Levy (2005) used the full version of the LSP as an online survey to gather data on management and IT skills, Boyatzis and Renio (1989) administered several surveys that included the Thematic Apperception Test (TAT), the LSI, and the Executive Skills Profile (ESP) to survey and gather data. The LSP was modeled to some degree

after the earlier version of the ESP. The overall results of Boyatzis and Renio's study showed that graduating students had stronger IGS, IAS, and TS. Their study was conducted in 1989 when IT use as a tool to manage data was expanding into every industry. Boyatzis and Renio (1989) noted from their study that the full-time MBA students increased their IGS, IAS, and TS significantly, while the part-time MBA students had only a slight increase in overall skill. They concluded from their findings that students must be evaluated to determine their skill deficiencies so that weaker or lacking skills can be addressed and students may have opportunities to expand or learn IT skills.

Assessing students' skills always has been a critical measure of learning. Levy (2005) concluded through his study with online MBA students that they significantly improved their IGS and their IAS. In contrast to the full version of the LSP, this research utilized a modified version of the LSP categories that included IGS, IAS, and TS as an online survey instrument to gather data from both groups. This study focused on quarrying specific IT skills that include IGS, IAS, and TS, which gave clear and concise data regarding both groups learning IT skills.

Physicians need to have IT skills, such as gathering information, to take advantage of current and emerging technologies that help the health care industry manage data. According to Hersh (2008), there is limited data on the IT skills of workers in the health care industry, although the data that exists shows deficiencies in health care workforce IT skills. Hersh (2008) also stated that there is no comprehensive assessment of IT skills in the health care workforce. This is an important statement that supports the assessment of IT skills of medical students. Hersh and Williamson (2007) have stated that

the health care industry has yet to benefit from IT since the health care workforce lacks IT training. Every health care facility needs at least one physician who is IT competent. Hersh and Williamson (2007) discussed IGS and IAS, which have been deemed necessary for physicians. Both gathering and analyzing skills are outlined by Hersh (2008) and Williamson (2007) and include the use of EMR and health information exchange, current and evolving decision support systems, as well as the organization and management of information systems. Hersh (2008) and Williamson (2007) successfully introduced to medical students a medical informatics course covering the use of IT to gather and analyze data. This study concentrated on IT skills learned while going through the osteopathic medical education process in contrast to taking an individual class or several courses in IT.

The growing use of IT in the medical field has created a need for health care professionals to learn IT skills, and for medical students to work with technology and expand these skills. Van Mulligen et al. (2007) stated that there is an urgent need for the medical professions, including medical students, to learn IT skills so that the enormous amount of medical data that continues to expand can be organized and integrated into the medical decision making process. This process has clinical utility, thus enhancing patient care and advancing the science of medicine. Since EBM is based on sound information and analysis to make decisions, strong IT skills are crucial. According to McGowan and Berner (2004), medical schools have no choice but to accept the responsibility to assess medical students' IT skills and to develop appropriate measures to address deficiencies or gaps in IT skills. There has been exponential growth in the need for health professionals trained to gather and analyze data using IT skills. "It is one thing to own a PC or have

access to one, quite another is to possess IT skills and to be IT literate" (Dorup, 2004, p. 6). Dorup stated that there continues to be a need to learn IT skills in medical school, and this will not disappear.

Understanding and regularly using IT skills enables learning and expanding existing IT skills, which are needed for growing health care networks and systems. Levy (2005) explained that IT skills are "the ability to use computers and computer networks to analyze data and organize information" (p. 6). Alavi and Leider (2001) argued that technology influences learning through processes such as searching and reviewing the results. Furthermore, Boyatzis and Kolb (1991) stated that IT skills are critical for quantitative comprehension and oral communications, which are skills doctors use on a daily basis. It is not difficult to find literature stating that IT skills are important components of medicine. Medicine and business are similar in that they deal with large amounts of data that must be gathered and analyzed. A study conducted by Boyle and Strong (2006) reviewed a higher education program that focused on enterprise resource planning (ERP). They reviewed literature and business school curricula to better understand what key IT skills are needed to train ERP students in a graduate program. They found that gathering and analyzing skills such as data management, using decision support systems, and the ability to adapt to new or growing IT systems are critical. This parallels similar skills medical students need to take advantage of the IT available to assist them in critical decision making. Managing information is necessary for all industries.

Another study that was structured to assess the IT skills of students as well as to support further research was conducted by Link and Marz (2006). They surveyed first

year medical students' computer literacy skills, which included utilizing the Internet for IGS and IAS. Findings from their research showed that most students utilized the Internet to perform rudimentary research, although their usage and IT skill level varied greatly. Advanced IT skill levels were identified as Web design and creating Hypertext Markup Language (HTML) documents, and these were very low or practically non-existent in medical students. The level of medical students' IT skills needs to be identified so that training or exposure to technology will help them develop the necessary IT skills to manage medical data. Verma, Paterson, and Medves (2006) stated that physicians need to use technology to gather and analyze medical data to optimize a patient's care and to be able to make decisions utilizing IT.

Gathering and analyzing information through the use of IT help physicians make better decisions regarding the overall health care of patients. Understanding what level of IT skills medical students have when they enter school ultimately will enhance their academic experience. Forman and Pomerantz (2006) surveyed medical students to better understand how they utilize IT when they gather and analyze large amounts of medical data. Their study surveyed basic IT skills such as using the Internet to advanced ones such as using database software and writing code. Forman and Pomerantz (2006) reported that most students had intermediate to somewhat advanced IT skills, while others had IT skills that were rudimentary. Medical students with lower IT skill levels reported that, if given a choice, they were less likely to take courses on the Internet. Forman and Pomerantz (2006) recommend the continued refinement of IT skills while in medical school. Table 2 consists of supporting literature for learning and IT.

Table 2. Learning and Information Technology Supporting Literature

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Association of Colleges and Research Libraries (2000)	Qualitative	Higher education workgroup	Higher education stakeholders/information literacy competencies	Standards were established for IT literacy.
Alavi and Leidner (2001)	Qualitative	Literature review	Questionnaire/technology and learning	More research is needed to help understand how technology skills affect student learning processes.
American Medical Association (2005)	Qualitative	Allopathic medical education	Medical education stakeholders/identification of skills gaps in medical education	Identification of strengths and gaps in the preparation of physicians. Managing information, which includes the use of technology, was identified.
American Medical Informatics Association (2008)	Qualitative	Health care workforce	Medical industry stakeholders/EMR core competencies	An official guide for learning IT skills specifically for the education and training of the health care workforce.
Boyatzis and Kolb (1991)	Qualitative	205 MBA students	Questionnaire/individuality in learning skills	The LSP is a valuable tool to analyze the learning of skills in organizations such as health care.
Boyatzis and Kolb (1995)	Qualitative	463 MBA students	Questionnaire/executive skills	Data shows reliability and relational validity, though the author suggests further validation. The ESP is a valuable feedback tool on skills and expectations to develop them.

Table 2. Continued

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Boyatzis and Renio (1989)	Qualitative	148 (full-time and part-time) MBA students	Questionnaire/impact of the MBA program	Overall positive skill development was observed in both groups, and IGS were strong for both groups, while higher scores for IT skills were observed for full-time students.
Boyle and Strong (2006)	Qualitative	105 IT professionals	Questionnaire/ERP skills	Key skills were identified for graduate ERP education, which is similar to what medical students need.
Dorup (2004)	Qualitative	1,159 first year medical students	Questionnaire/IT skills and attitudes	IT skills cannot be assumed. Students must be surveyed regarding their IT skill level.
Forman and Pomerantz (2006)	Qualitative	246 osteopathic medical students	Questionnaire/IT skills	Efforts to learn IT skills must continue during medical school.
Hersh (2008)	Qualitative	Literature review	Analysis of literature/health information technology skills	There is a need to assess IT skills in the health care workforce and more research is warranted.
Hersh and Williamson (2007)	Qualitative	400 physicians	Questionnaire/utilization of an online course	Successfully introduced an introductory medical informatics course to physicians.
Levy (2005)	Qualitative	84 MBA students (online and on-campus)	Questionnaire/learning skills	Cronbach's Alphas supported strong reliability of the LSP whose results were consistent with prior research. Online students showed increases in IGS and IAS skills, while on-campus students only increased three of the LSP skills measured.

Table 2. Continued

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Link and Marz (2006)	Qualitative	1,232 first year medical students	Questionnaire/computer literacy and attitudes towards e-learning	Deficiencies in IT skills of medical student must be identified and addressed.
Mainemelis, Boyatzis, and Kolb (2002)	Qualitative	314 MBA students	Questionnaire/learning	Learning style specialization develops higher analytical skill.
McGowan and Berner (2004)	Qualitative	516 citations	Literature review/curriculum objectives that teach physicians to use the Web	Medical schools must accept responsibility for helping medical students learn IT skills.
Van Mulligen et al. (2007)	Qualitative	180 BioMedical Informatics students	Questionnaire/Bio informatics interdisciplinary skills	The training program contributed to a multidisciplinary learning approach.
Verma, Paterson, and Medves (2006)	Qualitative	University faculty: medical, nursing, physical therapy, and occupational therapy	Interview/common standards for core competencies for health care professionals	Learning IT skills can be interchangeable, taught, and evaluated.

Information Gathering Skills

Physicians use IT such as imaging systems, telemedicine, decision support systems, integrated clinical information systems, EMR, computerized order entry systems, and other applications to manage information. The AMA (2005) organized a workgroup that reviewed in depth how medical doctors are prepared to work with IT, and it identified gaps, including the management of critical information. Managing information is critical for decision making that ultimately affects the health and well

being of patients. According to the AMA (2005), the industry needs to foster learning IT skills such as IGS, IAS, and TS in the professional setting to reduce these gaps, although learning IT skills during one's medical education is critical. Learning IT skills such as gathering critical information on a timely basis is an important skill that will enable future medical doctors to take advantage of various IT applications. According to Alavi and Leidner (2001), skills used to gather and analyze information are important for any profession. Levy (2005) stated that IGS requires the "ability to be sensitive to and aware of organizational events" (p. 6). Boyatzis and Kolb (1991) stated that IGS are sense-making skills that require critical thinking. Acquiring competent IGS would help doctors make better decisions based on timely information. Understanding the level of medical students' IGS is a core component upon which this study was focused.

Measuring the IT skills of medical students will set a benchmark of strengths and weaknesses or of gaps, giving faculty a blueprint from which to strengthen IT skills. All students assume they can gather information utilizing IT without an orientation to the medical library. According to Talja (2005), assumptions about IT skills may lead to chronic deficiencies and inadequate experience to draw upon when a medical student faces new or unusual IT situations. The AMIA (2008) reviewed the medical industry's workforce issues that focused on basic competencies in IT. This was accomplished through an in-depth analysis of the health care industry, including both professional and academic settings. According to the AMIA (2008), there is a need to invest in learning IT skills both in the professional setting and in the academic environment. Learning IT skills is a critical component of the health care system as it transforms itself through the use of

IT in areas such as clinical management systems and the push to incorporate EMR on a national scale (AMIA, 2008).

The ACRL (2000) conducted earlier work on IT literacy and stated that learning IT skills is a lifelong process and that institutions must measure IT skills consistently to better understand what IT skills students bring with them to class. "Curriculum integration increases the impact of student-centered teaching such as problem-based learning and evidence based learning…deeper level learning than is possible through exclusive use of lectures and textbooks…students use thinking skills requiring them to be skilled users of information sources" (p. 5). The ACRL (2000) further explains that incorporating IT skills training into the academic culture, rather than creating a separate class or course, is important. Building IT skills into the culture fosters the idea of lifelong learning. "Achieving competency in information literacy requires an understanding that this cluster of abilities is not extraneous to the curriculum but is woven into the curriculum's content, structure, and sequence" (p. 5). Lang (2003) conducted a survey of IT curricula in the health care field and reported from the results that health care professionals recognized that IGS and IAS are critical and necessary. These findings supported what the ACRL (2000) stated earlier that IT skills are critical. The AMA (2005) and the later work of the AMIA (2008) also support the theme of lifelong learning of IT skills. Lang (2003) noted that some health care education programs have included IT skills training in the curriculum as a course or class as opposed to building IT skills training into the culture as suggested by the ACRL (2000), the AMA (2008), and the AMIA (2008). Creating another course focused on technology skills is not advocated by the ACRL (2000) as an ideal way to educate students on IT skills.

There is a strong case to explore exactly what IT skills all health care students possess because as technology advances in sophistication in the health care industry, medical students are expected to be competent users of IT. Technology skills differ among health care industry professionals such as physicians and dentists and among medical and dental students. Romanov and Aarnio (2006) stated that use of IT was correlated with IGS. They conducted a web-based survey of approximately 800 medical and dental students and concluded that PC skills were not an important component when gathering information, though learning or enhancing medical students' IGS will ultimately increase their overall IT skills. McGowan and Berner (2004) examined the use of the Web to teach medical students how to use IT. According to McGowan and Berner (2004), in order to be competent at gathering information on the Web a medical student or physician must be able to understand the Web and develop Web-based research and analyzing skills. Romanov and Aarnio (2004) also stated that using multiple IT skills is critical for success; thus, there is a correlation between IGS, IAS, and TS.

Surveys regarding students in the health care field reveal that these students have more analytical IT skills associated with managing information, such as gathering timely and appropriate information to analyze and make EBM. Hersh (2008) stated through his research that students felt that more advanced skills such as database management and project management skills are important to the medical field. Both database management and project management require strong IT skills, which include gathering and analyzing. IT skills associated with using more sophisticated technologies such as clinical support systems and EMR require not only basic computer skills, but also more advanced skills that require deeper thought processes. Boyle and Strong (2006) reviewed important skills

in the business field of ERP and stated similar IT skills of gathering and analyzing as important for successful students. Garde et al. (2006) surveyed the IT skills of health professionals in Australia and acknowledged that health professionals need to have opportunities to learn IT skills, while their role in health care may dictate specific IT skills that need to be enhanced or learned. Table 3 consists of supporting literature for information gathering skills.

Table 3. Information Gathering Skills Supporting Literature

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Alavi and Leidner (2001)	Qualitative	Literature review	Questionnaire/ technology and learning	More research is needed to help understand how technology skills affect student learning processes.
Association of Colleges and Research Libraries (2000)	Qualitative	Higher education workgroup	Higher education stakeholders /information literacy competencies	Standards were established for IT literacy.
American Medical Association (2005)	Qualitative	Allopathic medical education	Medical education stakeholders /identification of skills gaps in medical education	Identification of strengths and gaps in the preparation of physicians. Managing information that includes the use of technology was identified.
American Medical Informatics Association (2008)	Qualitative	Health care workforce	Medical industry stakeholders/EMR core competencies	An official guide for learning IT skills specifically for the education and training of the health care workforce.
Boyatzis and Kolb (1991)	Qualitative	205 MBA students	Questionnaire/ individuality in learning skills	The LSP is a valuable tool to analyze the learning of skills in organizations such as health care.

Table 3. Continued

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Boyle and Strong (2006)	Qualitative	105 IT professionals	Questionnaire/ERP skills	Key skills were identified for graduate ERP education, which is similar to what medical students need.
Garde, Harrison, Huque, and Hovenga (2006)	Qualitative	462 health professionals	Questionnaire/ health IT skills	Depending on their work related tasks, health professionals need various levels of IT skills. A need also exists for training all health professionals.
Hersh (2008)	Qualitative	Literature review	Analysis of literature/health information technology skills	There is a need to assess IT skills in the health care workforce and more research is warranted.
Lang (2003)	Qualitative	221 health information management executives	Questionnaire/IT skills	Courses on IT should be added to health care curriculum.
Levy (2005)	Qualitative	84 MBA students (online and on-campus)	Questionnaire/ learning skills	Cronbach's Alphas supported strong reliability of the LSP whose results were consistent with prior research. Online students showed increases in IGS and IAS skills, while on-campus students increased only three of the LSP skills measured.
McGowan and Berner (2004)	Qualitative	516 citations	Literature review/curriculum objectives that teach physicians to use the Web	Medical schools are in an ideal position to work with students to learn IT skills.
Romanov and Aarnio (2006)	Qualitative	Approximately 800 medical and dental students	Questionnaire/ utilization of IT resources	There exist gaps in IT skills, which can be addressed by learning IT skills.

Table 3. Continued

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Talja (2005)	Qualitative	44 academic researchers: librarians and information services	Interviews/IT literacy	Self–assessments of IT skills are often misleading.

Information Analysis Skills

In the health care field, physicians must be able to analyze information accurately to make critical health care decisions affecting a patient's overall health. Levy (2005) stated that IAS can be defined as the "the ability to assimilate information from various sources" (p. 6). Earlier work conducted by the ACRL (2000) stated that students need to learn how to evaluate the source of information, analyze the content, and compare different sources of information, as well as use other technology tools such as a spreadsheet to reorganize the information and study interactions and outcomes. "In the context of the rapidly-expanding knowledge-base, many physicians are not prepared to expediently acquire, analyze, and synthesize information…many physicians are not prepared to utilize IT to assist in information acquisition and management" (AMA, 2005, p. 6). This critical review of medical doctors is important because it calls to attention a deficit in IT skills that potentially could affect health care decision making negatively. Lang (2003) supported the position that all health care workforce personnel must be proficient in using IT, especially gathering and analyzing information, and suggested that curriculum planners should offer courses such as clinical application systems, and systems integration analysis and design for students to learn IT skills. Incorporating

learning IT skills into the culture or weaving it throughout the medical education process seems to be the method of choice by the leading medical education groups and those in higher education. The AMIA (2008), the AMA (2005), and the ACRL (2000) all appear to suggest that the emphasis needs to be on incorporating learning IT skills into the culture of the education process as opposed to creating separate courses or classes within the medical school curriculum.

The AMIA (2008) specifically identified IGS, IAS, and TS as core competency skills for medical students, and developed core IT skills competencies for medical student education as well as for physicians. Core competencies focusing on IAS identified by the AMIA (2008) included: analyze data and information and distinguish between their differences; describe the structure and design of health information such as reports and data trends; identify incorrect data and take corrective action; identify methods and types of health care data collected; understand primary and secondary data sources and databases; analyze and resolve minor IT problems; understand and be able to make use of basic spreadsheets, word documents, and similar desktop management software; and identify and evaluate Web-based literature resources. These are skills similar to the ones identified by Hersh (2008) as being deficient in the overall health care industry workforce, although he also stated that there is limited data on what specific IT skills are lacking. In order to identify lagging IT skills and gaps that need to be addressed, Hersh (2008) stated that a comprehensive study needs to be conducted on IT skills in the health care industry. According to Hersh (2008), there will be a shortage of skilled IT workers in the health care industry in the near future, as well as a need to create a formal health informatics profession. This study explored the IT skills of osteopathic medical students

to better understand the IT skills medical students possess when they enter medical school as well as what IT skills they may learn during the medical school experience. This will help to better prepare future medical providers with the necessary IT skills.

Findings from a study conducted by Alavi and Leidner (2001) indirectly stated that there still remains an increased demand for both the quality and quantity of technology savvy graduates. They further explained that sound IGS will enable individuals to develop or utilize a variety of technologies in efforts to acquire data and information, but IAS will allow individuals to assimilate appropriate relevant information and is critical to the decision making process. Boyatzis, Stubbs, and Taylor (2002) stipulated that the primary challenge in graduate education is to develop IAS, which helps to manage data and information leading to knowledge. This also is an important component of the ACRL (2000), which pointed out that it is not only important but critical. According to Boyatzis and Kolb (1991), IAS is critical for abstract conceptualization, which is important for theory building, and therefore conceivably would be a valuable skill physicians would need. Systems analysis, clinical operating systems, and EMR all require multiple IT skills including the ability to analyze, which may be the most critical for EBM. McGowan and Berner (2004) stated that EBM is grounded in IT management and needs to be part of the medical student's learning experience in medical school.

Gathering information and then interpreting the findings are part of the medical decision making process based on gathering evidence. Searching for information is a critical skill that medical students need to develop to care for patients when using an evidence based approach. Lau and Coiera (2007) conducted a study on the effect of bias

on gathering and analyzing skills with approximately 80 health care professionals and over 200 medical students in Sydney, Australia and found that bias may play a role in how information is analyzed. Prior IT experience or lack of experience may create a bias; this is important because it plays a major role in how information is gathered. If a physician has less than desirable experience with gathering information, then the data they collect may be less desirable and may affect the clinical decision making process negatively, causing an adverse health outcome. This scenario may lead to a less than accurate medical decision, thus compromising the patient's health and potentially placing the physician in a position of liability for malpractice. Westbrook, Gosling, and Coiera (2004) stated that physicians who increasingly utilize IT will enhance their existing skills in collecting data, enabling better decision making and health outcomes.

Analyzing skills are critical in all fields of higher education. The ACRL (2000) stated that a student who is information literate would be able to analyze information by comparing information from various IT sources. Analyzing information consists of evaluating the IT used to retrieve the information; the technology's reliability, validity, and accuracy; and the logic supporting the technologies used (ACRL, 2000). Boyle and Strong (2006) researched the IT skills of graduate level ERP students and found that higher level thinking skills involved in analyzing were important, as self-reported by students on their survey. Medical students are taught to conceptualize and think by linking past experiences and reviewed evidence, which can be associated with gathering information and analyzing skills. Table 4 consists of supporting literature for information analysis skills.

Table 4. Information Analysis Skills Supporting Literature

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Alavi and Leidner (2001)	Qualitative	Literature review	Questionnaire/ technology and learning	More research is needed to help understand how technology skills affect student learning processes.
American Medical Association (2005)	Qualitative	Allopathic medical education	Medical education stakeholders/ identification of skills gaps in medical education	Recommend strategy to help medical students learn IT skills while in medical school.
American Medical Informatics Association (2008)	Qualitative	Health care workforce	Medical industry stakeholders/EMR core competencies	Recommend medical students learn IT skills such as IGS, IAS, and TS while in medical school.
Association of College and Research Libraries (2000)	Qualitative	Higher education workgroup	Higher education stakeholders /information literacy competencies	Analyzing skills are crucial for higher education.
Boyatzis and Kolb (1991)	Qualitative	205 MBA students	Questionnaire/ individuality in learning skills	The LSP is a valuable tool to analyze the learning of skills in organizations such as health care.
Boyatzis, Stubbs, and Taylor (2002)	Qualitative	MBA students (part-time and full-time)	Questionnaire/ learning skills competencies	IGS, IAS, and TS increased with part-time online MBA students.
Boyle and Strong (2006)	Qualitative	105 IT professionals	Questionnaire/ERP skills	Key skills were identified for graduate ERP education, which is similar to what medical students need.
Hersh (2008)	Qualitative	Literature review	Analysis of literature/health information technology skills	There is a need to assess IT skills in the health care workforce and more research is warranted.

Table 4. Continued

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Lang (2003)	Qualitative	221 health information management executives	Questionnaire/IT skills	Courses on IT should be added to health care curriculum.
Lau and Coiera (2007)	Qualitative	75 medical clinicians and 227 undergrad students	Questionnaire/IT skills with information retrieval systems	Attitudes, preferences, and moods will affect how one analyzes information.
Levy (2005)	Qualitative	84 MBA students (online and on-campus)	Questionnaire/ learning skills	Cronbach's Alphas supported strong reliability of the LSP whose results were consistent with prior research. Online students showed increases in IGS and IAS skill, while on-campus students increased three of the LSP skills measured.
McGowan and Berner (2004)	Qualitative	516 citations	Literature review/curriculum objectives that teach physicians to use the Web	Medical schools are in an ideal position to work with students to learn IT skills.

Technology Skills

The growth and impact of IT as a tool in the medical field have become indispensable, and advances in technology will continue to expand the range of uses for IT in the health care industry. Therefore, it is critical to keep current with these advances as well as with learning IT skills (Hersh, 2008). Computerized clinical systems, EMR, and other technologies all have contributed to increased efficiency and quality, enabling more robust EBM. Hersh (2002) stated that IT skills such as IGS, IAS, and TS must be learned because they directly relate to the practice of medicine. This study is not arguing

that students entering medical school do not have IT skills (all students have some degree of IT skills); rather it is exploring what increases in IT skills medical students may have gained during their academic experience. Talja (2005), Gibson and Silverberg (2000), and Lynch et al. (2000) clearly have documented that there has been a less than desirable focus on learning IT skills in medical education institutions.

The ability to access technology throughout one's academic career is a fundamental necessity similar to accessing learning materials using a library. Not having access to learning IT skills will lead to job performance issues that eventually will need to be addressed. Ameh, Kene, and Ameh (2008) surveyed computer skills of medical students in Nigeria at the end of their academic experience. These students had little or no IT related experience when they entered medical school, and learning IT skills was not part of the overall medical academic curriculum. Ameh et al. (2008) stated that their survey results showed that the IT experience and knowledge of clinical year medical students were low and that it is critical for medical students to have an opportunity to learn IT skills while in school. Seago, Schlesinger, and Hampton (2002) surveyed the IT skills of medical students starting their academic experience in the United States, and had results opposite to those of Ameh et al. (2008), whose study focused on IT skills of students at the end of their medical education. This is important because it shows that there presently exists an IT gap for those that do not have the means or the access and those that have access and can capitalize on it. The study by Seago et al. (2002) resulted in data showing that medical students starting their academic experience in the United States have basic to advanced IT skills, yet there remains a need to assess continually student IT skills to determine issues or gaps to be addressed. It is the aim of this study to

survey the IT skills of both medical students starting their medical education and those about to finish their medical education in an effort to better understand the differences in skill levels, given the two groups had similar credentials at entry and had similar demographic descriptive. A study by Samuel et al. (2004) assessed the IT skills of medical students in Tanzanian and stated from their conclusions that IT skills in this medical school from South Africa were low, and that not having access to IT such as a personal computer continues to be an issue. Again, the issue of those who have access to a computer and those who do not becomes important regarding learning IT skills. Medical students accepted into medical school come from a variety of backgrounds, including underserved and inner-city areas where students may be of a lower economic status and have a disadvantage in terms of access and means.

Kim, Hsu, and Stern's (2006) study on IT skills in academia and industry identified gaps in IT skills between what is being taught at the university level and what industry demands. They surveyed both sectors throughout the northeastern United States and concluded not only that there is a need for student IT skills education, but also that industry lacked these critical IT skills. Workplace deficits in IT skills were discovered through survey results analyzed by Kim et al. (2006). Also, feedback from this study showed a need for future academic curricula to include an emphasis on learning these emerging technologies. A limitation of the Kim et al. (2006) study was that the survey went out to only the northeastern United States, thus having limited generalizability. However, this is still an important study that supports the research to determine if there are significant differences in IT skills between osteopathic medical students entering their first year of study and those who are graduating. Boyle and Strong (2006) conducted

research with graduate students concentrating in ERP and concluded that basic IT skills including gathering and analyzing are crucial for systems analysis and design, which are important components of ERP.

Boyatzis and Kolb (1991) suggested that there are links between learning IT skills and the academic experience. Boyatzis and Kolb (1991, 1995) further stated that learning IT skills such as IGS, IAS, and TS are enhanced by the use of technology, and that the LSP was the assessment tool ideally suited to measure what students learn during their academic experience. Lang (2003) argues that there is a need for academics to focus on learning IT skills, though many medical schools already have adopted its importance and have started incorporating facets of IT throughout the curriculum, allowing for opportunities to weave IT into the overall academic experience. Lang (2003) further discussed that health care leaders and academia have recognized that the management of information is an important skill that is lacking. According to Lang (2003), technology expertise such as writing code or designing complex systems may not be necessary, but a good overall understanding of IT is necessary and "curriculum planners should focus academic planning efforts for technical knowledge more in the area of concept articulation than actual expertise" (p. 378). This is an important concept that might not be fully understood by physicians who might feel that they need to be an expert in all facets of medicine as well as in IT.

Link and Marz (2006) conducted research that surveyed IT skills and attitudes of first year medical students at the Medical University in Vienna and reported that 12% of the medical students surveyed felt that accessing technology such as the Internet to gather information was not that important, and therefore they seldom used it. Conclusions were

that a separate IT course is needed for medical students who are identified through an assessment tool as having less than adequate IT skills. Information technology skills such as utilizing the Internet to search credible information using a variety of IT skills to manage that information are critical (ACRL, 2000). The AMA (2005) and the AMIA (2008) both stated the importance of learning IT skills. Professional education such as medical school may be the best place to teach critical IT skills (McGowan & Berner, 2004). Hersh (2008) strongly stated that even though the health care industry has adopted IT as part of medicine, there is still a need for learning IT skills because there are deficiencies throughout the industry. Hersh (2008) also stated that since we do not have an assessment of IT skills that analyze the entire industry, there might be a shortage of a well trained IT savvy health care workforce in the near future. Table 5 consists of supporting literature for information technology skills.

Table 5. Technology Skills Supporting Literature

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Ameh, Kene, and Ameh (2008)	Qualitative	230 medical students	Questionnaire/IT skills	IT skills are low with this group.
American Medical Association (2005)	Qualitative	Allopathic medical education	Medical education stakeholders/ identification of skills gaps in medical education	Recommend strategy to help medical students learn IT skills while in medical school.
American Medical Informatics Association (2008)	Qualitative	Health care workforce	Medical industry stakeholders/EMR core competencies	Recommend medical students learn IT skills such as IGS, IAS, and TS while in medical school.
Association of College and Research Libraries (2000)	Qualitative	Higher education workgroup	Higher education stakeholders/ information literacy competencies	Analyzing skills are crucial for higher education.

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Boyle and Strong (2006)	Qualitative	105 IT professionals	Questionnaire/ERP skills	Key skills were identified for graduate ERP education, which is similar to what medical students need.
Hersh (2008)	Qualitative	Literature review	Analysis of literature/health information technology skills	There is a need to assess IT skills in the health care workforce and more research is warranted.
Lang (2003)	Qualitative	221 health information management executives	Questionnaire/IT skills	Courses on IT should be added to health care curriculum.
Link and Marz (2006)	Qualitative	1,232 first year medical students	Questionnaire/ computer literacy and attitudes towards e-learning	Medical students need a class on basic IT skills; and some, once identified as having inadequate IT skills, may need ongoing training.
McGowan and Berner (2004)	Qualitative	516 citations	Literature review/curriculum objectives that teach physicians to use the Web	Medical schools are in an ideal position to work with students to learn IT skills.
Samuel et al. (2004)	Qualitative	92 medical students	Questionnaire/ information communication technology skills	Little or no access to IT has created a need for medical students to learn IT skills.
Seago, Schlesinger, and Hampton (2002)	Qualitative	1,771 first year medical students	Questionnaire/ computer literacy	There exists a continuous need to assess the incoming IT skills of medical students.

Age and Gender

Increasingly, physicians are utilizing advanced technology in the medical field to record data and to conduct research, while medical students are utilizing computerized exams, taking courses, and practicing their clinical skills using computerized simulated exercises. The health care industry continuously spends enormous resources, both time

and money, on training, including learning IT skills (Atreja et al., 2008). According to Passyn, Diriker, and Settle (2011), age is a factor that must be taken into consideration with regards to technology use. The age and gender issues reviewed in this section include IT utilization, examination performance abilities using IT, IT attitudes, IT access and use, and the impact of age on the acquisition of IT skills. This literature review is by no means an exhaustive investigative analysis of age and gender; it is rather an exploratory review of literature with a focus on age and gender as it relates to learning IT skills.

According to Atrej et al. (2008), the use of IT in the health care setting as a tool in the learning process is satisfactory regardless of gender or age. However, they admitted that there is limited research in this area and that the effects of their study might not be due to any specific variable. They stated that the literature available on the IT skills of students is focused on small groups of individuals who have good IT skills and similar backgrounds. Their study surveyed a broad spectrum of health care employees whose education levels as well as their IT skills were varied. This is important because it shows a strong degree of generalizability. Atrej et al. (2008) measured IT skills as developed through the medical school experience, which is tailored to specific tasks, though they neglected to examine a broader range of IT skill utilization.

Kies, Williams, and Freund (2006) conducted research earlier that had similar results to Atrej et al. (2008). Kies et al. (2006) surveyed first year medical students to determine if there are differences in gender when using computer-based examinations. Although Kies et al. (2006) did not measure actual IT skills of medical students, their study came to the conclusion that there is no difference between genders when it comes

to using IT as a test taking tool. Kies et al. (2006) examined a medical student's ability to perform on computer-based exams by having a student use a computer to access the Web, find the Web page, sign in, and take the test by clicking on a radio button. The IT skill needed to take these examinations was fundamental at best. This study failed to look at potentially deeper issues such as gaps in IT skills by analyzing actual IT skills as well as learning IT skills.

According to Knight and Pearson (2005), there has been a major shift in worker demographics across all industries including health care. There are increased numbers of older workers in the workforce, as well as more women who are employed. Knight and Pearson (2005) explained that in order to stay competitive and take advantage of current and emerging technologies, organizations must update their employees' IT skills continually. From 20 different companies, they sampled approximately 360 participants whose jobs required that they use several forms of IT throughout the day to perform tasks. Their study examined several components of IT skills, including what effects age and gender might have on learning IT skills. Their study concluded that there is no difference between age and gender regarding computer usage and IT skills. However, they stated that more research is needed in this area to better understand how age and/or gender might affect the actual learning of IT skills. Their work was limited to surveying workers who use computers on a daily basis and not those who use computers less frequently or have limited access. This is important because it points out the need for ongoing training to learn IT skills for workers who are considered proficient, and it demonstrates a need to research the IT skills of those who use technology less frequently.

Knight and Pearson (2005) studied computer skills and the relationship that age has on learning. Limiting factors of Knight and Pearson's (2005) research were that they reviewed age covering a span of five years (27 to 31) and only surveyed workers who had to use a computer throughout the day to complete their tasks. Knight and Pearson (2005) concluded that since everyone in their survey had IT skills, they assumed that everyone had learned at least some IT skills and therefore there were no differences in IT skills between age and gender. They also stated that further exploration of IT skills is called for in an effort to better understand age and gender as it relates to IT skills.

Reed, Doty, and May (2005) studied older adults in the workforce, and reported that age is a valid factor regarding access to IT, confidence with IT, and learning IT skills. Reed et al. (2005) stated that there are few studies supplying empirical evidence in this area. Although they studied older adults, the results are supporting evidence that if one does not have access to IT, one may not be comfortable dealing with technology; this could create potential difficulties learning or expanding existing IT skills. Reed et al. (2005) stated that if anyone, regardless of age, has minimal exposure to IT, it may lead to less experience and minimal skill level, which explains lower levels of IT performance using computers. Acceptance and willingness to pursue learning IT skills successfully, whether on one's own time or through some type of organized learning, may be due to one's overall past experiences with IT (Reed et al., 2005).

Earlier work of Schumacher and Morahan-Martin (2001) contradicts Knight and Pearson (2005) by stating that there is in fact a difference with gender and learning IT skills. Schumacher and Moraham-Martin (2001) conducted research involving gender and use of IT, specifically the use of the internet, over an eight year period and showed

results indicating that differences do in fact exist between genders, with males appearing to be more comfortable and competent when learning IT skills. Schumacher and Morahan-Martin (2001) found through their research that people from rural areas, those with limited education, people with limited income, and females are all important factors that may influence learning IT skills. According to their study, this is where the gap exists between those who have IT skills and those who do not. Most students accepted to medical school have some level of IT skills they bring with them, while some have limited or none. Medical students are recruited from rural areas, from families with limited income, and some are female, all factors that impact learning IT skills, according to Schumacher and Morahan-Martin (2001). This appears to have importance for medical schools because they always will have a cohort of students with various backgrounds and IT skill level that falls into this category and these students may need assistance learning IT skills. Thus, assessment is critical.

Knight and Pearson's (2005) study focused on knowledge workers and IT skills, concluding that there were no differences between the genders, while Smith (2005) did research on learning IT skills in an academic setting and found evidence of a difference between genders and learning IT skills. Smith (2005) and earlier findings of Schumacher and Morahan-Martin (2001) reported that differences in IT skills exist between age and gender. Smith (2005) reported that women scored higher than men on computer anxiety and that men had higher IT skills scores. Smith (2005) also stressed the importance of having the opportunity to learn IT skills while in school and that acquiring IT skills is critical for academia and career progress. The academia experience needs to stress learning IT skills and applying them since it positively affects one's overall career. Smith

maintained that further study of this issue is necessary and warranted, and stated that gaps in IT skills must be identified and addressed during the academic experience, allowing students to learn IT skills so they will make successful progress through their academic experience as well as in their chosen career path. Table 6 consists of supporting literature on age and gender.

Table 6. Age and Gender Supporting Literature

Study	Methodology	Sample	Instrument/ Constructs	Main Findings or Contributions
Atreja et al. (2008)	Qualitative	17,898 health care professionals from six hospital systems	Questionnaire/Web based skills and age	Technology is a satisfactory mode of learning regardless of age or gender.
Kies, Williams, and Freund (2006)	Qualitative	374 first year medical students	Questionnaire/gender and IT skills	No difference between genders using IT.
Knight and Pearson (2005)	Qualitative	352 voluntary knowledge workers, 50 % male and 50 % female	Questionnaire/age and gender, and IT skills	No significant difference with computer usage between age and gender of knowledge workers.
Reed, Doty, and May (2005)	Qualitative	113 volunteers	Questionnaire/IT skills and age	Age plays a role with learning IT skills and confidence levels.
Schumacher and Morahan-Martin (2001)	Qualitative	619 voluntary incoming undergraduate college students	Questionnaire/gender attitude and technology	With increased usage of computers, differences in age and gender diminish, though females still felt less confident and comfortable with computers.
Smith (2005)	Qualitative	310 students	Questionnaire/gender and racial differences with IT skills	Men reported more confidence than women with computers, supporting earlier research that a digital divide exists between those who have and those who do not.

Summary of Known and Unknown Issues

A review of the literature outlines common threads regarding learning IT skills. The literature outlines learning skills, IGS, IAS, and TS, as well as how age and gender may affect learning IT skills. Boyatzis and Kolb (1995) conducted important research regarding learning and skills and developed a survey instrument, the LSP, based on existing instruments that measured learning and skill. Levy (2005) stated that IT skills are abilities that utilize technologies to gather and analyze information. Boyatzis and Kolb (1991) also did work in the area of determining skill as encompassing knowledge, experience, and ability. Hersh (2008) stated that there seems to be limited knowledge on what IT skills workers in the health care field possess. Hersh (2008) also stated that there is a lack of training medical students and of exposing them to opportunities to learn IT skills. Hersh and Williamson (2007) were able to record some success with establishing an IT course for medical students, but limited research is available on learning IT skills outcomes. The ACRL (2000) stated that learning IT skills should be woven into the culture of the curriculum, rather than offering a separate course or class. Link and Marz (2006) conducted limited research on the IT skills of medical students and concluded that gaps do exist. The AMIA (2008), AMA (2005), and the ACRL (2005) identified strengths and weaknesses in the preparation of medical doctors, and developed standards and guidelines for learning IT skills. These are the overall critical components that drove this research.

There are several unknown issues regarding medical students learning IT skills, which the literature seems to be missing. There is sparse information analyzing and critically evaluating the IT skills of medical students starting school as well as evaluating

the IT skills of medical students who are graduating. This is important to better understand and determine what IT skills they enhanced or gained while going through the medical school experience. Hersh (2008) stated that to his knowledge, there is no research that comprehensively evaluates the IT skills of the American health care system or of those individuals who currently are attending school to prepare for a career in the health professions. One other area that seems to be missing from the literature is what effect, if any, the current state of IT skilled or unskilled workforce has on health care outcomes.

Chapter 3

Methodology

Research Methods

This study used a group comparison design utilizing a survey instrument to gather data on the IT skills of group 1: students entering their first year of osteopathic medical school, and group 2: newly graduated osteopathic medical doctors who recently graduated from medical school and were entering the workforce. Both groups had similar gender distribution and MCAT scores. Kretovics and McCambridge (2002) stated that it's important to find similarities between separate groups and compare them to strengthen validity. A systematic way to measure student learning is to compare student competencies at the beginning and end of their education experience. The unit of analysis and the targeted population for this study were students attending an osteopathic medical school in the southeastern United States. This study investigated osteopathic medical students learning IT skills during the medical school experience as well as whether age or gender had an effect on learning IT skills.

The main research question that this study addressed was: What role does the osteopathic medical school experience and demographics information have on learning IT skills? The four specific research questions that this study addressed were (RQ1)

What role does the osteopathic medical school experience have on learning IGS for students entering medical school and for those who are graduating? The second specific research question was (RQ2): What role does the osteopathic medical school experience have on learning IAS between students entering medical school and those who are graduating? The third specific research question was (RQ3): What role does the osteopathic medical school experience have on learning TS for students entering medical school and for those who are graduating? The fourth specific research question was (RQ4): Are there significant differences between the three IT skills (information gathering skills, information analysis skills, and technology skills) between students entering osteopathic medical school and those who are graduating, based on their age and gender? The survey consisted of 3 skills categories with 6 survey items each, for a total of 18 survey items. The survey instrument was developed based on Boyatiz and Kolb (1991)'s validated LSP instrument to gather raw data, which was analyzed and the results used to address the study's research questions.

Specific Procedures to be Employed

Population and Sample

The population frame was all osteopathic medical students in medical colleges across the United States. The subset of the population was the sample, which included all osteopathic medical students at NSU's COM, located in southeastern United States. The sample of this study consisted of first year students entering osteopathic medical school (group 1), and those who were new graduates of the medical school (group 2). The estimated sample size was 230 first year osteopathic medical students and 200 newly graduated osteopathic medical doctors; thus, the total estimated sample size was 430.

According to Gay and Airasian (2003, p. 113), if the population is over 5,000, then a sample of approximately 400 would be adequate. Blewett and Kisamore (2009) surveyed medical students at Oklahoma State University, Center for Health Sciences and received a response rate of 32%. Their sample size was 430 and they had 137 responders. This study's survey yielded 102 responses or 24%. Several strategies were used to help achieve the response rate: 1) an initial invitation was sent via email; 2) the survey was announced during the Dean's hour for the new medical students; 3) reminders were sent via email to all medical students two days before the close of the survey; 4) the survey was short and straight forward; and 5) there was easy access to the survey via the Web. Osteopathic medical students are familiar with short surveys as they often are surveyed regarding course content, course materials, and course instructors.

Institutional Review Board (IRB) paperwork was filed for this research and its approval (see Appendix A). IRB clearance is needed prior to any survey at the university to ensure ethical conduct is maintained with any research involving human subjects. Permission also was obtained from the university to collect data prior to the survey being administered (Appendix B).

Pre-analysis Data Cleaning

The aggregate demographic data on characteristics of osteopathic medical students entering medical school were reviewed against newly graduated osteopathic medical doctors entering the workforce. According to the NSU HPD Catalog (2009-2010), the COM admissions policies for incoming osteopathic medical students as well as the medical school program design have remained consistent over the past four years. According to the Catalog, IT skills (word processing, Internet, and email capabilities) are

required to fulfill admission to medical school. In addition, satisfactory grades, a grade point average (GPA) of 3.0 on a 4.0 scale in core science courses (general biology, organic chemistry, general chemistry, and physics) are required for entering osteopathic medical students. As well, the requirements for the core science courses have not changed over the past four years. The MCAT scores of both groups were compared. Medical school national trends in age, gender, MCAT scores, and IT skills were self-reported on the survey instrument and reviewed. According to Julian, Ingersoll, Etienne, and Hilger (2004), aggregate MCAT scores from 1994 to 2000 have not changed significantly nor has the gender make-up (53% men and 47% women).

There were four critical areas of raw data that were taken into account because of their potential effect on the validity of any conclusions drawn from the data (Mertler and Veannatta, 2001). The four areas were: accuracy of the data collected, response-set, missing data, and the effects of extreme cases. Levy (2005) stated that reviewing the collected raw data from the survey for accuracy and resolving issues or irregularities is a critical first step toward supporting the preparation of data. Valid results can be derived only from data that is accurately given, collected, and imputed. The second critical area as explained by Levy (2005) is response-set (the same score is recorded for all items), which is an obvious threat to any results, thus negatively affecting the validity. The third area that must be reviewed is any missing data, which defiantly compromises validity, according to Mertler and Veannatta (2001). Missing data may skew or alter results and thus not reflect accuracy. The final area is outliers or extreme cases. Mertler and Veannatta (2001) stated that extreme cases or outliers may significantly alter an accurate conclusion drawn from the data.

Each of the four areas: accuracy, response-set, missing data, and extreme cases were addressed to provide assurance against problematic irregularities. For example, accuracy such as penciling in data or poorly worded items can affect the data collection greatly. To address this potential problem the survey was done via the Web. Survey responses were reviewed to ensure they were response-set (all items scored the same) and, if necessary, discarded. The issue of missing data was addressed through the use of the Web-based survey. All survey items were required for the survey submission, thus forcing the participants to complete their survey before submitting it. Finally, extreme cases or outliers also may alter or skew the analysis of the collected data from the survey. Data collected from the survey instrument was reviewed for extreme cases. According to Mertler and Veannatta (2001), outliers have strong effects on data analysis and can render the results insignificant, when in fact they may be significant once the extreme case is removed. Thus, following Mertler and Veannatta's approach, this study assessed multivariate outliers using Mahalanobis-Distance. Extreme cases were reviewed and were considered for removal prior to the final analysis.

Instrument Development

By utilizing previous research and scholarly work, the early research of Boyatzis and Kolb (1991) led to the development of the LSP, which was adapted from the Executive Skills Profile (ESP). The ESP identifies the following categories of skills as important points to be analyzed: interpersonal learning skills, information skills, analytical skills, and behavioral skills, and has been used in research focusing on skills feedback in manufacturing, research labs, management development programs, and which included physicians as well as physician executives. The LSP is a measure

consisting of a total of 12 learning skills with 72 items that include the IT skills of students. Since these skills were the focal point of this study, the survey instrument (Appendix C) used the portion of the LSP that focuses on IT skills. The survey instrument consisted of 18 items derived from the 72-item LSP. The 18 items were divided into three learning IT skills: (1) information gathering, (2) information analysis, and (3) information technology, which were identified in the literature by Chen (2005), Hersh (2002), and Staggers et al. (2000) as important for the health professions. Each learning skill on the survey instrument had 6 items for a total of 18 items. The data gathered from the survey instrument was analyzed for the differences of the increases (i.e. the delta) between the groups among the three aforementioned skill sets.

Earlier classic background research that led to the LSP was conducted by Boyatzis and Renio (1989). They utilized a value-added, cross-sectional design measuring entering students into the MBA program, and those who completed the program. Kretovics and McCambridge (2002) stated that comparing two separate groups that are similar in demographics and knowledge level is the ideal and they further explained that "one systematic way to measure student learning would be to compare measures of student competencies at the beginning and end of their education experience" (p. 3). This study surveyed osteopathic medical students' IT skills at the beginning and end of their academic experience. Rather than waiting four years, which was not a practical length of time for conducting this study, the survey was conducted during the fall and spring of the same year. Boyatzis and Renio (1989) proposed the question that asks if the students' abilities have improved since entering the program. Similar research conducted by Levy (2005) analyzed managerial skills, which included

the IT skills of full-time students in MBA programs. Levy (2005) utilized the LSP as the survey instrument to gather data on student IT skills. This study utilized an abbreviated version of the LSP instrument to focus specifically on IT skills of both groups during the same year.

Other steps in the instrument development included securing permission from the medical school dean's office as well as the administration of the Health Professions Division to survey the osteopathic medical students. The survey was voluntary and students were encouraged to participate. Once the committee approved the data collection, the survey was posted on surveymonkey.com. Surveymonkey.com is a secure site allowing anyone to develop a survey; both groups logged onto the site and filled out the survey within the time allotted. The survey data then was collected.

Validity and Reliability

Both of the groups, first year osteopathic medical students and newly graduated osteopathic medical doctors during the same academic year, were surveyed for this study. Boyatzis and Renio (1989) stated that assessing students' abilities or skills when they enter a program is a crucial benchmark that can be used to measure against the graduates of that program, and then studied to determine if there are significant differences in IT skills between the groups during their academic experience. Measuring the two groups to see if they are the same will address a limitation of the validity. Building on this validity, both groups attended the same university with an administration that has not changed; thus, both separate groups had the identical policies and procedures. A limitation of the study is that there were two separate groups measured during the same academic year. The other limitation is that only one medical school in the southeastern United States was

used for this study, which may affect generalizability. However, Sieber (2009) conducted an online survey assessing basic IT skills of first year medical students at the University of Oxford. Sieber (2009) reported the results as a case study and stated that the basic IT skills of first year medical students were consistent over a three year period 2004, 2005, and 2006 at the University of Oxford, and also showed that some medical students had a definite lack of basic IT skills while others were well prepared. The Sieber (2009) study is an important step forward to understanding what IT skills medical students bring with them to medical school, and parallels with this study. Siber (2009) surveyed basic IT skills such as using word processing software, finding information on the Internet, and using a spreadsheet. Arora (2007) conducted a study, based on inputs from the University of North Carolina School of Medicine and Informatics in Medical Education and Development, on basic IT skills of first year medical and dental students at Christian Medical College Ludhiana, India. The results reported by Arora (2007) stated that only 30% of the medical and dental students had basic IT skills, though 90% could use a computer to surf the Web. Both studies by Siber (2009) and Arora (2007) demonstrated some degree of generalizability.

The internal and external validity of this study was addressed by carefully constructing the survey instrument items so that they were reflective of the constructs and variables. According to the seminal work by Straub (1989), the internal validity of a study is concerned with whether variables that were unaccounted for affected what was observed. Straub (1989) further elaborated that to strengthen internal validity, all variables and related constructs must be scrutinized meticulously for accuracy, meaningfulness, and credibility. To help minimize internal validity threats for this study,

a sample group of faculty reviewed the survey instrument for accuracy, and meaningfulness as it related to construct validity. Internal validity controls must try to eliminate any other possible explanation for the results of the survey. To help strengthen the internal validity of this research the same survey instrument was used for both groups. Data was accumulated from both groups using the same series of items that were tested for construct validity by faculty. Subjects were asked to volunteer in the study by taking the survey instrument online. It was anticipated that the triangulation of data from both groups would help to strengthen the validity.

Cook and Campbell (1979) stated that external validity is concerned with whether the results of a study are the same (generalization of the study) utilizing similar subjects, organizations, and survey instruments as well as other parameters. This study utilized an existing survey instrument (LSP), which has been used successfully over the years in rigorous research. The LSP has been used successfully in similar research done with business students (Levy, 2005). It was anticipated that by utilizing this survey instrument the results would be an accurate assessment. To help strengthen external validity and generalization, only first year osteopathic medical students and newly graduated osteopathic medical doctors from the same medical school participated in this research, which could be replicated at any medical school in the world. Age, gender, and prior academic requisites to entering medical school as well as MCAT scores all represented a particular set of characteristics that were identical for both groups; thus, it was a strong representative sample of an osteopathic medical student.

The survey only was available via the Web, which will help standardize the survey instrument in an effort to strengthen its reliability. The use of the same survey to

measure the incoming and graduating osteopathic medical students also will help to demonstrate stability of the measure as well as consistency. Results from the data collected from both groups were analyzed for their reliability using Cronbach's Alpha.

Important research on validity conducted by Straub (1989) stressed that instrument validation is critical to the results and meaningfulness of the findings. Instrument validations consist of content and construct measures. Content validity as explained by Straub (1989) focuses on whether the survey items are derived from all possible sources that are measurable. The survey instrument was taken from the LSP, which has been tested over time and has strong content and construct validity. Boyatzis and Kolb's (1991) work on the LSP established the "LSP's reliability, relational validity, and criterion and construct validity...the LSP instrument was designed to assess learning skills in health care" (p. 294). Straub (1989) explained in his seminal work that instrument reliability is the measurement's accuracy and errors must be minimized for accurateness. This survey instrument had subjects respond to items using a Likert-type scale, whose results were rated and then analyzed using Cronbach's Alpha.

According to Marakas, Johnson, and Clay (2007), since content validity is an important aspect of instrument development, each question needs to contribute to the overall construct. This technique, which showed high reliability and internal consistency, was used successfully by Johnson and Marakas (2000). The survey responses were rated on a Likert scale (1-7).

Levy (2005), Boyatzis and Kolb (1991), Boytzis and Renio (1989), and Kretovics (1999) conducted similar studies (students entering an MBA program and those who completed one) focusing on IT skills and competencies utilizing the LSP. Kretovics'

(1999) results seemed to confer with earlier works of Boyatzis and Kolb (1991) that there is a high Cronbach's Alpha, indicating strong measures of reliability. Levy conducted similar research and achieved results consistent to those of Kretovics (1999). Boyatzis and Kolb (1991) concluded that the "LSP is demonstrating better relational validity with slightly lower overall inter-correlation of the scales than the ESP" (p. 285). Seminal work conducted by Straub (1989) stated that instruments utilized in Management Information Systems (MIS) research could be based on referenced disciplines such as the cognitive sciences, which would allow for strong validity. In similar studies conducted by Kretovics (1999) using LSP, Cronbach's Alpha was reported to confirm earlier works of Straub that the measures were highly reliable.

Format for Presenting Results

Data Analysis

Boyatzis and Renio (1989) stated that it is important to analyze the aggregated mean and display it on a star-graph. Each set of the LSP skills was measured using a one-way analysis of variance (ANOVA) testing significance, with Cronbach's Alpha testing for reliability for each set of skills as well as vector analysis analyzing the delta between the groups. Vector analysis is a two dimensional (showing both groups) star-type graph displaying aggregated mean for each selected skills. Boyatzis and Kolb (1991) assessed relational validity of the LSP by analyzing the scale vectors and their positioning of information gathering, information analysis, and technology skills. Boyatzis and Kolb (1991) discussed scales with two-dimensional learning that showed a high degree of inter-correlation. Also, information analysis skills strongly corresponded

to abstract conceptualization. This analysis will help to demonstrate whether there were differences between the groups.

Boyatzis and Kolb (1991, 1995) utilized a star-type graph to display the results of individual skills of the LSP. This study used a similar type graph to display the vector analysis results. The aggregate mean of each skill (IGS, IAS, and TS) is shown on a separate axis, along with points for each of the survey items. Data collected from first year medical students and newly graduated osteopathic medical doctors were analyzed and grafted to see if any differences occur. Figures 1, 2 and 3 are examples of star-grafts where data was entered into and grafted and displayed for IGS, IAS, and TS.

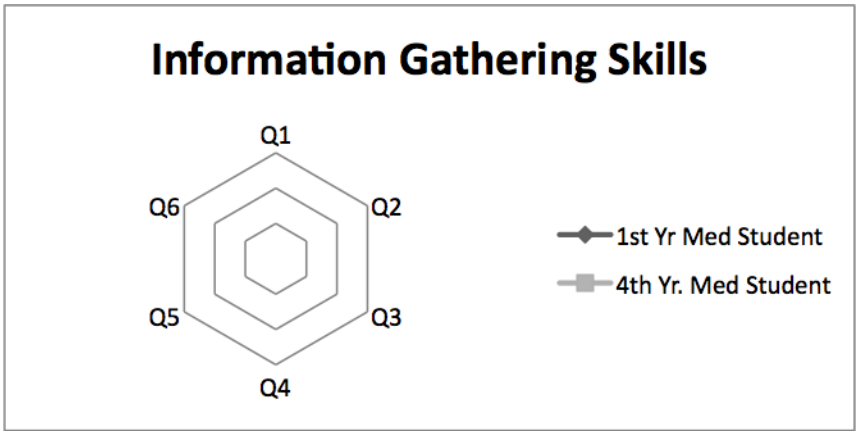

Figure 1. Star-graft of how IGS will be displayed.

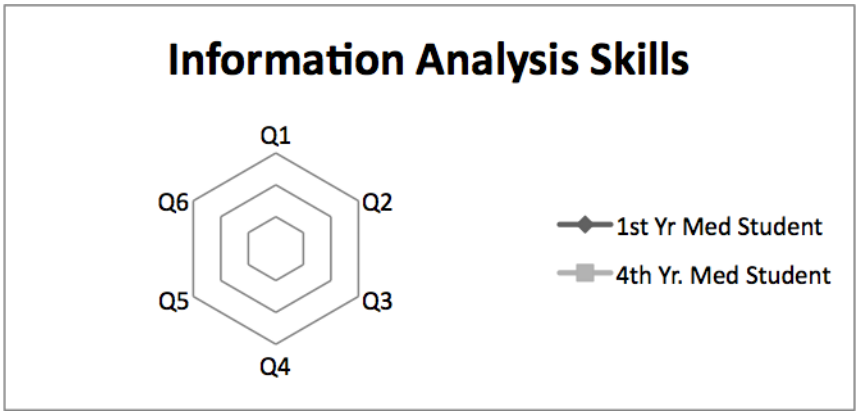

Figure 2. Star-graft of how IAS will be displayed.

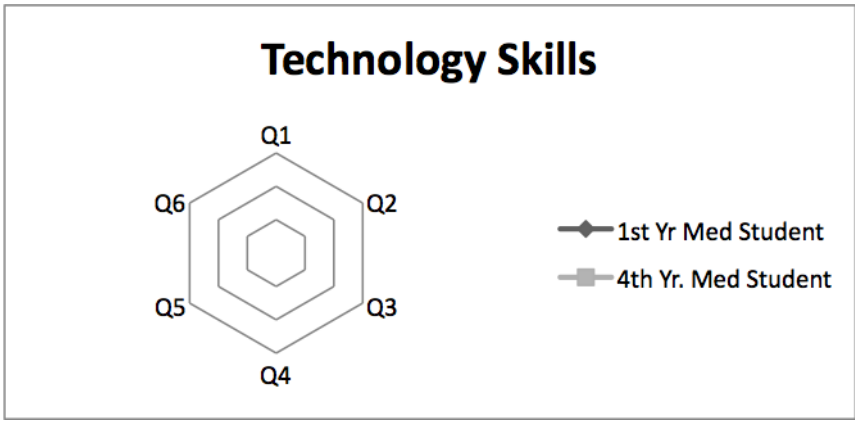

Figure 3. Star-graft of how TS will be displayed.

The survey instrument had a total of 18 items. Each of the survey items was categorized under IGS, IAS, and TS. Each skill was addressed by six corresponding items within the survey instrument. Two-dimensional vector analysis (star-type graph) was used to study two separate points, entering and graduated osteopathic medical students. Vector analysis showed the delta between the groups. The analysis utilized one-way ANOVA testing significance as well as Cronbach's Alpha to test for reliability. Entering osteopathic medical students and those who had just graduated were independent variables and the three learning skills (IGS, IAS, and TS) were dependent variables. Demographic information was collected and studied alongside the corresponding data.

Each of the specific research goals was addressed by a corresponding research question. The first specific research goal was to empirically assess the role that the osteopathic medical school experience has on learning IGS between students entering medical school and those graduating. The corresponding research question (RQ1) for this goal asked: What role does the osteopathic medical school experience have on learning

IGS for students entering medical school and for those who are graduating? The survey instrument gathered data for each of the RQs, and the results from the analysis of the data derived from the survey addressed the RQs. After both groups filled out the survey instrument, IGS-1 to IGS-6, the data was collected and analyzed. Each group was measured for significance using a one-way ANOVA. Each separate skill set was tested for reliability using Cronbach's Alpha. Once the data was analyzed, it was grafted using a vector analysis to see whether a delta existed between the groups.

The second specific research goal was to empirically assess the role that the osteopathic medical school experience had on learning IAS for students entering medical school and for those who were graduating. The second RQ2 asked: What role does the osteopathic medical school experience have on learning IAS for students entering medical school and those who are graduating? After both groups filled out the survey instrument, IAS-1 to IAS-6, the data was collected and analyzed. Each group was measured for significance using a one-way ANOVA. Each separate skill set was tested for reliability using Cronbach's Alpha. Once the data was analyzed, it was grafted using a vector analysis to see whether a delta existed between the groups.

The third specific research goal was to empirically assess the role that the osteopathic medical school experience had on learning TS for students entering medical school and for those who were graduating. This corresponding research question (RQ3) asked: What role does the osteopathic medical school experience have on learning TS for students entering medical school and for those who are graduating? After both groups filled out the survey instrument, TS-1 to TS-6, the data was collected and analyzed. Each group was measured for significance using a one-way ANOVA. Each separate skill set

was tested for reliability using Cronbach's Alpha. Once the data was analyzed, it was grafted using a vector analysis to see whether a delta existed between the groups.

The fourth specific research goal was to empirically assess the differences of the three IT skills (IGS, ITS, and TS) between students entering osteopathic medical school and those who were graduating, based on their age and gender. RQ4 asked: Are there significant differences of the three IT skills (IGS, IAS, and TS) between students entering osteopathic medical school and those who are graduating, based on their age and gender? Part A and B of the survey gathered data that was analyzed. Demographic information collected from the survey instrument was analyzed alongside the statistical results produced from the survey data to determine if there were any significant differences between the both groups.

Resources Required

This study utilized publications available through a digital library housed at the NSU main campus in Fort Lauderdale, Florida. A nominal cost was incurred to have the survey instrument on the Surveymonkey.com Web site. Surveymonkey.com was used to house the survey because it allowed both groups to have access to the service at any time of the day. Any printing or mailing costs were nominal.

Summary

Chapter 3 described in detail the methodology used for this study. A group comparison design utilizing a Web-based survey instrument was used to collect data. The target population was first year osteopathic medical students and newly graduated osteopathic medical doctors entering the workforce. The paperwork for IRB was filed and clearance was obtained. As part of the initial data screening, osteopathic medical

students were analyzed for their MCAT scores, age, and academic capabilities. Irregularities were scrutinized via accuracy, response rate, missing data, and extreme cases. The instrument was a stratified version of the LSP created by researchers Boyatis and Kolb (1991). The validity and reliability of the LSP is well documented. The survey instrument was used to gather data from each group and to address each of the RQs. The results from the analysis of the data derived from the survey addressed the RQs. Analysis of the data consisted of several components: one-way ANOVA (significance), Vector Analysis (differences between the groups), and Cronbach's Alpha (reliability).

Chapter 4

Results

Overview

Results of this study are presented in this chapter. The first component of this chapter consists of the exploration phase of the study, which is followed by the quantitative phase. The quantitative section had sub-sections, which included: pre-analysis and data cleaning, including accuracy, response-set, missing data, and extreme cases; reliability analysis; age normalization factor; Mann Whitney U test analysis; vector analysis; and test between subject's analysis. A summary of results concludes the chapter.

The format of the Web-based survey instrument was developed to streamline the overall length and minimize data entry errors, as well as to increase ease of access. The study consisted of two groups: first year osteopathic medical students and newly graduated osteopathic medical doctors entering the workforce. Medical school faculty announced to the first group the voluntary survey with the URL at the Dean's hour and an email was sent later as a reminder. A similar email was sent asking the second group to participate in this voluntary survey, with a link to the URL provided. The approximate sample size for both groups was 430. The total responses were 102. All 102 responses were usable after pre-analysis and data cleaning. Gender distribution included 30 males and 21 females from the first year medical student group, and 31 males and 20 females from the graduated osteopathic medical doctor group. The MCAT scores mean average for the first group was 28.12, which was almost identical to the second group's score of

28. The mean age of the first group was 25.3, while the mean age of the second group was almost 31, resulting in a difference of 5.6 between the two groups. The distribution of gender was similar for both groups, who also had similar MCAT scores, increasing the generalizability.

Exploration

The survey was distributed to both groups during the 2010 academic year. The first year osteopathic medical students were surveyed during September 2010, while the newly graduated osteopathic medical doctors were surveyed during May 2010. The Web-based survey was administered on SurveyMonkey.com, and consisted of three sections: information gathering skills, information analysis skills, and technology skills. Each of these sections consisted of a series of six survey items. The voluntary survey, including the URL and instructions, were introduced to the first group by faculty from the osteopathic medical school at the Dean's hour; this was followed by an email. A similar email was sent to the second group. Approximately 430 potential respondents were asked to fill out the Web-based survey. The survey was available for both groups for approximately two weeks. A total of 102 responses (24%) were collected and utilized for this research.

The raw data collected from the survey instrument was analyzed according to the outline of this study's methodology. The results of the analyzed data addressed the four research questions: RQ1: What role does the osteopathic medical school experience have on learning IGS for students entering medical school and for those who are graduating?; RQ2: What role does the osteopathic medical school experiences have on learning IAS for students entering medical school and for those who are graduating?; RQ3: What role

does the osteopathic medical school experience have on learning TS for students entering medical school and for those who are graduating?; and RQ4: Are there significant differences among the three IT skills (information gathering skills, information analysis skills, and technology skills) between students entering osteopathic medical school and those who are graduating, based on their age and gender?

Quantitative Data Analysis

Pre-analysis Data Screening

Prior to analyzing the data collected from the survey instrument, the raw data was carefully reviewed for accuracy, response-set, missing data, and extreme cases. The survey was on the Web, which permitted error free input and tabulation, thereby allowing for strong accuracy. Participants also chose from a series of supplied responses to answer the questions. Data was analyzed for response-set, which refers to respondents using the same response for each item. It is important to check response-set even though Kerlinger and Lee (2000) stated that overall it is a mild threat to valid measures. Data was reviewed carefully for response-set and found to be clean. The data was reviewed and found to have no missing data values to report. The data was analyzed for extreme cases using Mahalanobis distance (Table 7). Mahalanobis distance analyzed the cases' distance from the mean, generated from the raw data collected from the survey instrument, of all the remaining variables or centroid. Case 43 from the first group and case 100 from the second group were discovered as extreme cases (Figure 4). After careful consideration, case 43 and case 100 remained in the data due to similar values.

Table 7. Mahalanobis Distance Results

			Case Number	Case ID	Value
Mahalanobis Distance	Highest	1	43	43	43.62132
		2	100	100	42.55691
		3	37	37	38.18409
		4	47	47	37.57385
		5	39	39	37.47750
	Lowest	1	66	66	2.47403
		2	63	63	2.47403
		3	64	64	2.90946
		4	71	71	3.61492
		5	55	55	4.12474

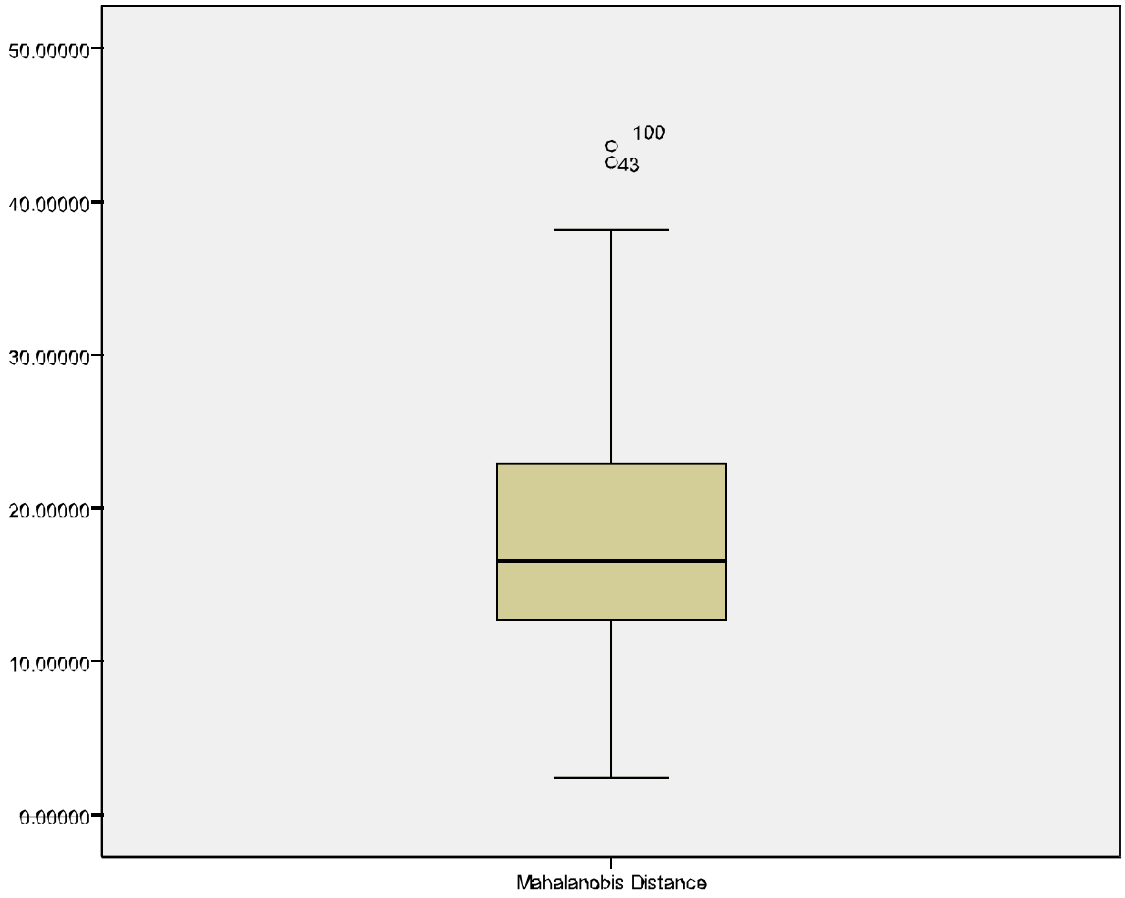

Figure 4. Mahalanobis distance results showing extreme cases 43 and 100.

Figure 4 displays the graphical results of Mahalanobis distance showing outliers. CaseID 43 and CaseID 100 both had critical values > 42. CaseID 43 was from the first group and CaseID 100 was from the second group. Since both values were not extreme from the groups or from each other, it was decided to keep both cases in the data set.

Reliability Analysis

Straub (1989) stated that instrument reliability is measured using Cronbach's Alpha, and a large Cronbach Alpha (>0.70) is indicative of strong survey reliability. This is confirmed by the later work of Hair, Black, Babin, Anderson, and Tatham (2006) and Sekaran (2003). This survey used Cronbach's Alpha and Table 8 shows the results of the analysis as high Cronbach's Alpha on all three information technology skill sets (IGS, IAS, and TS), which were >0.70, demonstrating strong survey reliability.

Table 8. Results of Reliability

Learning Skill	**Cronbach's Alpha**	**Number of Items**
Information Gathering Skills	.886	6
Information Analysis Skills	.934	6
Technology Skills	.937	6

Non Parametric Mann Whitney U Analysis

The Non Parametric Mann Whitney U test is utilized to examine if there are significant differences by measuring the dependent variable using an ordinal scale (Sekaran, 2003). The Non Parametric Mann Whitney U test was used to determine if the

individual learning skills within the skills groups (IGS, IAS, and TS) were affected by the medical school experience. The results of the analysis showed IGS1, IGS2, IGS6, IAS1, IAS2, IAS3, IAS4, and IAS5 as significant (p=0.001); IGS3 as significant (p=0.01); and IAS6 and TS5 as significant (p=0.05). However, IGS4, IGS5, TS1, TS2, TS3, TS4, TS5, and TS6 were not significantly affected. The Non Parametric Mann Whitney U test results for all three groups (IGS, IAS, & TS) are displayed in Table 9.

Table 9. Results of the Non Parametric Mann Whitney U Test

Learning Skill	Entering (N=51)		Graduating (N=51)		One way ANOVA			Non Parametric (Mann Whitney U Test)	
	M	SD	M	SD	F	P		Z	Sig 2-1
IGS1	**4.88**	**1.07**	**7.07**	**1.86**	**53.00**	**0.00**	*******	**-6.66**	**0.00**
IGS2	**3.90**	**1.02**	**5.13**	**1.27**	**29.22**	**0.00**	*******	**-5.23**	**0.00**
IGS3	**4.39**	**1.27**	**5.02**	**1.26**	**6.35**	**0.01**	******	**-1.82**	**0.06**
IGS4	5.29	1.04	5.31	1.24	0.01	0.93		-1.01	0.31
IGS5	4.55	1.19	5.00	1.21	3.59	0.06		-1.16	0.24
IGS6	**4.37**	**1.09**	**5.07**	**1.24**	**8.98**	**0.00**	*******	**-2.18**	**0.02**
IAS1	**4.33**	**1.21**	**5.31**	**1.21**	**16.69**	**0.00**	*******	**-3.36**	**0.00**
IAS2	**4.37**	**1.15**	**5.28**	**1.29**	**14.03**	**0.00**	*******	**-2.99**	**0.00**
IAS3	**4.55**	**1.15**	**5.29**	**1.28**	**9.48**	**0.00**	*******	**-2.39**	**0.01**
IAS4	**4.35**	**1.26**	**5.25**	**1.20**	**13.45**	**0.00**	*******	**-2.93**	**0.00**
IAS5	**4.47**	**1.14**	**5.18**	**1.31**	**8.54**	**0.00**	*******	**-2.31**	**0.02**
IAS6	**4.76**	**1.05**	**5.25**	**1.26**	**4.40**	**0.04**	*****	**-1.15**	**0.24**
TS1	3.92	1.53	4.19	1.43	0.83	0.37		-0.53	0.56
TS2	3.96	1.70	3.92	1.54	0.02	0.90		-0.20	0.80
TS3	3.71	1.63	3.90	1.47	0.38	0.54		-0.52	0.60
TS4	3.84	1.59	3.78	1.53	0.04	0.85		-0.50	0.61
TS5	**2.27**	**1.51**	**1.71**	**1.33**	**4.00**	**0.05**	*****	**-0.66**	**0.50**
TS6	3.22	1.64	2.88	1.60	1.08	0.30		-0.97	0.32

*****p<0.001**
****p<0.01**
***p<0.05**

Technology Skills of Entering Versus Graduated Osteopathic Medical Doctors

Figures 5, 6, and 7 are star-graphs showing the difference in mean scores of both groups. Figure 5 addresses RQ1: What role does the osteopathic medical school experience have on learning IGS for students entering medical school and for those who are graduating? Figure 5 shows the aggregated mean results from responses to each of the IGS survey items. Responses to survey items IGS1, IGS2, IGS3, IGS5, and IGS6 were significant and showed an enhancement in learning skills. However, responses to survey items IGS1 and IGS2 show a larger delta or spread than responses to survey items IGS3, IGS5, and IGS6. Response to survey item IGS4 was not significant.

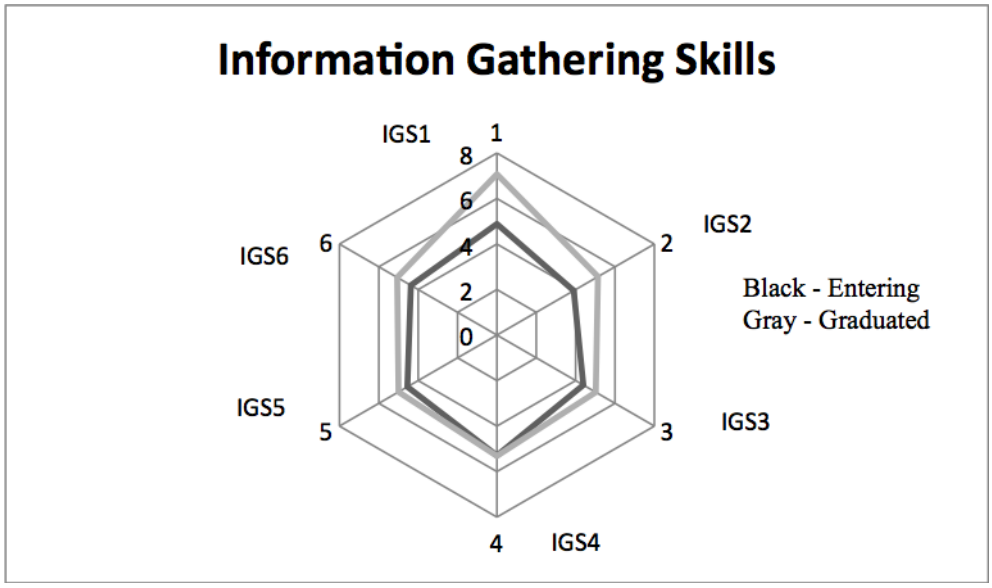

Figure 5. Star-graft of Information Gathering Skills results.

Figure 6 shows the aggregated mean results from responses to each of the IAS survey items. Figure 6 addresses RQ2: What role does the osteopathic medical school experiences have on learning IAS for students entering medical school and for those who are graduating? Responses for each of the survey items IAS1 through IAS6 showed a

significant enhancement in learning skills. Responses to survey items IAS1 through IAS5 were more significant than the response to IAS6.

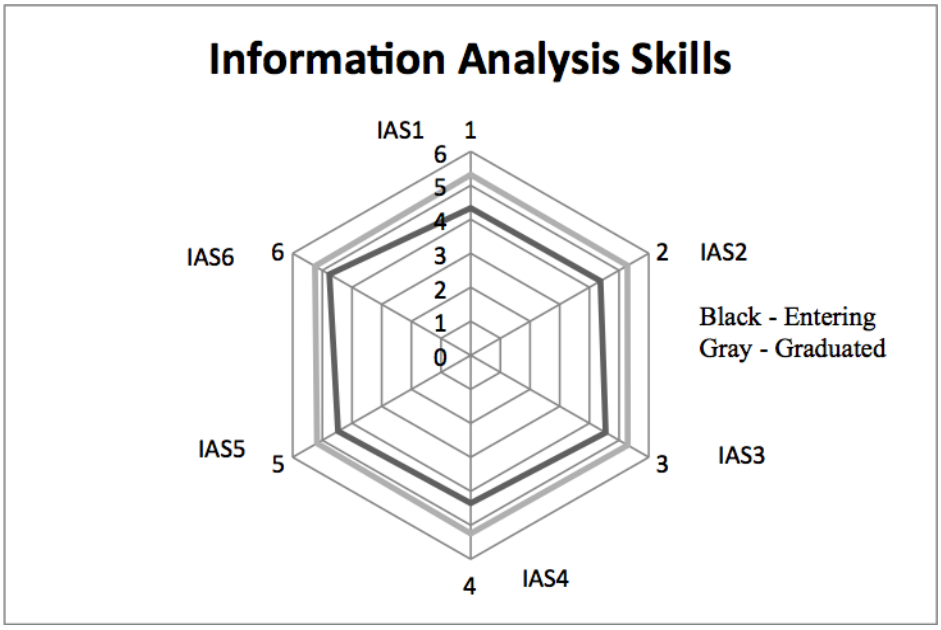

Figure 6. Star-graft of Information Analysis Skills results.

Figure 7 shows the aggregated mean results from responses to each of the TS survey items on the survey. Figure 7 addresses RQ3: What role does the osteopathic medical school experience have on learning TS for students entering medical school and for those who are graduating? Results of responses for survey items TS1, TS2, TS3, TS4, and TS6 showed not to be significant. The response to TS5 was a significant difference, showing higher mean scores for graduated osteopathic medical doctors. Results for TS1 through TS4 were not significant, and while TS6 showed some differences, it was not significant.

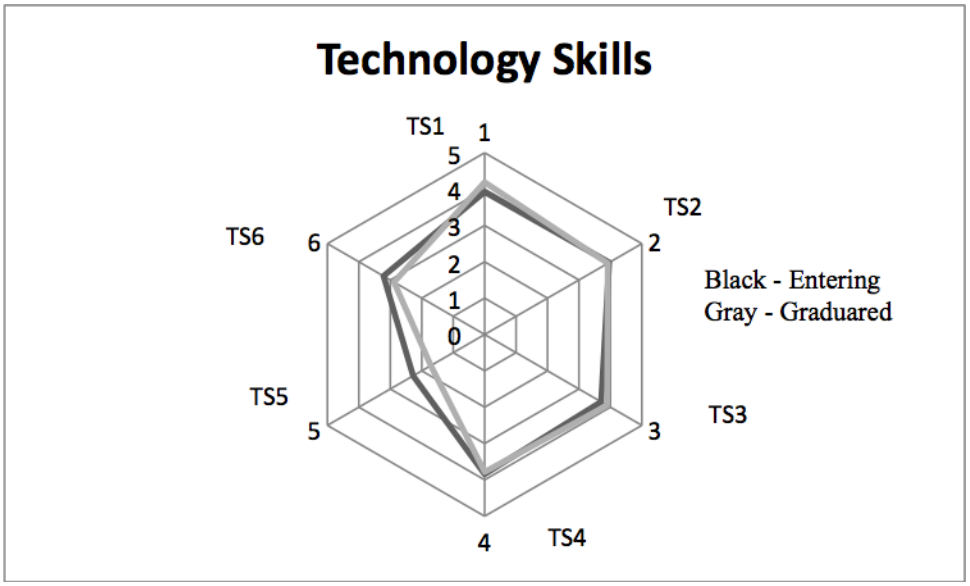

Figure 7. Star-graft of Technology Skills results.

Demographic Analysis

The survey instrument quarried demographic information that included age and gender. Demographic data was collected and analyzed. Tables 10, 11, and 12 address RQ4: Are there significant differences among the three IT skills (information gathering skills, information analysis skills, and technology skills) between students entering osteopathic medical school and those who are graduating, based on their age and gender? Table 10 analyzed age and gender between subjects and groups of those who responded to the IGS survey items. Table 11 analyzed age and gender between subjects and groups of those who responded to the IAS survey items. Table 12 analyzed age and gender between subjects and groups of those who responded to the TS survey items.

Table 10 shows a demographic analysis of IGS. Stage showed a significant difference between the groups (p=.004). Gender showed a borderline significance between the groups (p=.061), while the results of the analysis for age showed no significance between the groups (p=.475).

Table 10. Information Gathering Skills Test of Between Subject Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
Corrected Model	441.188[a]	3	147.063	4.359	.006	
Intercept	1981.367	1	1981.367	58.735	.000	
Stage	**286.631**	**1**	**286.631**	**8.497**	**.004**	****
Age	17.313	1	17.313	.513	.475	
Gender	**120.758**	**1**	**120.758**	**3.580**	**.061**	*****
Error	3305.931	98	33.734			
Total	90460.299	102				
Corrected Total	3747.119	101				

*****p<0.001**
****p<0.01**
***p<0.05**

Table 11 shows demographic analysis of IAS. Stage showed a significant difference between the groups (p=.001). Gender showed a significant difference between the groups (p=0.011), while the results of the analysis for age showed no significance between the groups (p=.540).

Table 11. Information Analysis Skills Test of Between Subject Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
Corrected Model	824.022[a]	3	274.674	7.124	.000	
Intercept	2070.252	1	2070.252	53.694	.000	
Stage	**466.157**	**1**	**466.157**	**12.090**	**.001**	*******
Age	14.584	1	14.584	.378	.540	
Gender	**258.388**	**1**	**258.388**	**6.702**	**.011**	******
Error	3778.525	98	38.556			
Total	91559.879	102				
Corrected Total	4602.547	101				

*****p<0.001**
****p<0.01**
***p<0.05**

Table 12 shows demographic analysis of TS. Stage showed no significance between the groups (p=1.00). Gender showed a significant difference between the groups

(p=0.04), while the results of the analysis for age showed no significance between the groups (p=.555).

Table 12. Technology Skills Test of Between Subject Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
Corrected Model	539.309[a]	3	179.770	2.985	.035	
Intercept	1675.032	1	1675.032	27.815	.000	
Stage	4.192E-6	1	4.192E-6	.000	1.000	
Age	21.128	1	21.128	.351	.555	
Gender	**531.682**	**1**	**531.682**	**8.829**	**.004**	****
Error	5901.508	98	60.219			
Total	49974.325	102				
Corrected Total	6440.817	101				

***p<0.001
**p<0.01
*p<0.05

Summary of Results

Results of the data collected from the voluntary survey were analyzed and reported in table and chart formats. The two major components of this chapter consisted of the exploration phase and the quantitative phase with several sections. The exploration phase of this chapter discussed the survey instrument implementation. The quantitative phase of this chapter reported the results of the data that was collected, screened, and analyzed.

The survey instrument was developed using the LSP model. The sample included approximately 430 individuals, out of which 102, or nearly 24%, participated. The voluntary Web-based survey instrument focused on two groups of potential respondents. The first group of participants consisted of first year osteopathic medical students, while the second group consisted of newly graduated osteopathic medical doctors entering the workforce. Both groups were asked to participate in the survey, which was available for a two-week period to both groups. The survey responses were rated using a five point Likert scale. Overall from both groups, 102 or 24% responded to the survey. The raw data was collected, screened, and analyzed. The results were used to answer the research questions by this study. The results answered the four research questions this study. RQ1, RQ2, and RQ3 were displayed by star-grafts (Figures 5, 6, and 7). Tables 10, 11, and 12 displayed results of data analysis, which addressed RQ4.

Chapter 5

Conclusions, Implications, Recommendations, and Summary

Conclusions

This chapter consists of the overall conclusions drawn from the results of the study. A discussion of the research questions is presented as well as the implications. The results of the study and its contribution to the existing body of knowledge are reviewed. Future research and recommendations are discussed, followed by the conclusions.

The main research goal of this study was to determine what role the osteopathic medical school experience and demographics have on learning IT skills (IGS, IAS, and TS). The two phases of the study were explorative and quantitative. The population consisted of first year osteopathic medical students and newly graduated osteopathic medical doctors entering the workforce. The overall response rate to the survey instrument by both groups was 24%. The raw data was screened and then analyzed using Microsoft Excel and SPSS software.

An extensive review of the literature resulted in a common theme that argued that medical students are not exposed to opportunities to learn new or enhance existing IT skills, such as gathering and analyzing information, or to opportunities to utilize

information technology to collect and manage information. These skills are critical to preparing future osteopathic medical doctors. Baseline skills for IGS, IAS, and TS were supported by literature (Table 1). An extensive literature review yielded supporting documentation for learning information technology skills and appears in Table 2. Table 3 consists of supporting literature for information gathering skills. Table 4 contains supporting literature for information analyzing skills. Table 5 consists of literature supporting technology skills. Table 6 is the result of a literature search focused on age and gender and learning information technology skills. The results of the literature research supported the development of the survey instrument. Levy and Murphy (2002), as well as the earlier work of Keeney (1999), support the use of reviewing literature as a means to develop a survey instrument.

The data was collected and analyzed for extreme cases using Mahalanobis distance (Table 7). Two cases (case 43 and case 100), one from each group, were found to be extreme, and yet had similar values; case 43 had a value of 43.62123 and case 100 had a value of 42.55691. After careful analysis, they both remained in the data since it was felt that they would not detract from the overall analysis. Reliability of the instrument was measured using Cronbach's Alpha (Table 8). Results were the IGS skill set was .886, the IAS skill set was .934, and the TS skill set was .937. Cronbach's Alpha score was strong for all three learning skill sets (IGS, IAS, and TS).

The Non Parametric Mann Whitney U test was used to determine whether the medical school experience had an effect on individual learning skills within the skills groups (IGS, IAS, and TS). Results (Table 9) showed IGS1, IGS2, IGS6, IAS1, IAS2, IAS3, IAS4, and IAS5 as being significant ($p=0.001$); IGS3 as being significant ($p<0.01$);

and IAS6 and TS5 as being significant (p=0.05). However, IGS4, IGS5, TS1, TS2, TS3, TS4, TS5, and TS6 were not significant.

Responses to the survey were aggregated and the mean was used to analyze the results of both groups. The aggregated mean from both groups were inputted on a star-type graft (Figures 5, 6, and 7) in an effort to determine if a delta existed between the groups.

The first research question this study addressed was: What role does the osteopathic medical school experience have on learning IGS for students entering medical school and for those who are graduating? Results of Cronbach's Alpha (Table 8) for all the IGS survey items was .886, which is well above >0.70, an indicator of strong survey reliability. The non parametric Mann Whitney U test (Table 9) showed survey items IGS1, IGS2, IGS3, and IGS6 as being significant. IGS5 was borderline significant. Results of this analysis showed that there was an increase in learning information technology skills in the IGS category. Figure 4 shows IGS1, IGS2, IGS3, IGS5, and IGS6 as significant, indicating an enhancement in learning IGS. Romanov and Aarnio (2006) stated that learning and/or enhancing medical students IGS ultimately would increase their overall IT skills. The results showed that there was an increase in IT skills due to the osteopathic medical school experience.

The second research question that this study addressed was: What role does the osteopathic medical school experiences have on learning IAS for students entering medical school and for those who are graduating? Results of Cronbach's Alpha (Table 8) for IAS survey items was .934, which is well above >0.70, an indicator of strong survey reliability. The non parametric Mann Whitney U test (Table 9) showed survey items

IAS1 through IAS6 as being significant. It is important to note that the medical school experience had an impact. The results of this analysis showed that there was an increase in learning information technology skills in the IAS category. Figure 5 shows IAS1 through IAS6 as significant, indicating an enhancement in learning IAS. Lau and Coiera (2007) stated that if the IAS of medical doctors is less than desirable, then decisions made from data collected and analyzed might have adverse effects on a patient's health outcome.

The third research question that this study addressed was: What role does the osteopathic medical school experience have on learning TS for students entering medical school and for those who are graduating? Results of Cronbach's Alpha (Table 8) for TS survey items was .937, which is well above >0.70, an indicator of strong survey reliability. The non parametric Mann Whitney U test (Table 9) showed TS5 as being significant. These results may be due to a generational gap. Students entering their first year of medical school have grown up with increased access to technology devices such as cell phones, computer games, and computers in school from elementary school to high school and in the home. Newly graduated osteopathic medical students entering the workforce would not have had such opportunities to access technology devices because they were not as widely available. Therefore, newly graduated osteopathic doctors' use and access to technology would have been considerably less. Results of this analysis showed that there was only one question that showed a significant increase in learning information technology skills in the TS category. The results seemed to indicate that there was not an increase in IT skills. Figure 6 shows TS5 as being significant and TS1, TS2, TS3, TS4, and TS6 as not significant, indicating there was not an enhancement of

learning TS. More research is warranted in this area. Keeping up with advances in IT in health care is critical in the delivery of health care (Hersh, 2008).

The fourth research question that this study addressed was: Are there significant differences among the three IT skills (information gathering skills, information analysis skills, and technology skills) between students entering osteopathic medical school and those who are graduating, based on their age and gender? Test between groups showed IGS (Table 10) stage (both groups) as significant. Age was not significant, while gender showed a borderline significance. The results pointed out that there was a significant increase in learning IGS, though age and gender were not significant. Tests between groups showed IAS (Table 11) stage and gender as significant, while age was not significant. The results pointed out that stage and gender showed a positive increase in learning IT skills. The results for TS (Table 12) showed that stage and age were not significant, though gender was. Overall, the demographic analysis showed stage and gender were impacted by the medical school experience for IGS and IAS. However, the results showed that in the category of TS, gender had an increase in learning IT skills, while stage and age were not impacted.

Implications

This study and the results have several implications for the existing body of knowledge of medical student education and the preparation of osteopathic medical doctors entering the workforce. Results from the data seem to indicate that medical students need to be exposed to opportunities to learn IT skills to better prepare them to enter the workforce. There is a need to understand what IT skills a student has when entering medical school to better address their shortcomings and to prepare them to enter

the workforce. This study explored only one osteopathic medical school. This study can be duplicated in other osteopathic medical schools as well as allopathic medical schools nationally to increase our understanding of the IT skills of medical students and the academic experience. A unique survey instrument was developed through an extensive literature search and use of the LSP as a model. This model was developed with the potential that the survey might be used with both osteopathic and allopathic medical students throughout the country.

Important contributions of the study are the results from each of the IT skills areas. As evident in the research into the literature, prior work into the area of IT skills of medical students is limited and covers the basic use of word processing and email, at best. Previous research on the consequences of limited or weak IT skills of medical students is scarce. Quarrying and identifying the IT skills of medical students will have far-reaching effects in medical student education. Knowing IT skills and understanding medical students' lack of or limitations in these skills will help academic faculty and administrators develop teaching plans that accurately address student needs. If it becomes policy that medical students participate in an IT skills analysis to evaluate them as they enter school, then deficiencies and weaknesses in IT skills can be addressed accurately. Additionally, medical students would be prepared to enter the workforce and immediately contribute to the delivery of care utilizing the IT skills they developed and fine-tuned while attending medical school.

Study Limitations

There were several study limitations. The first limitation included the exclusive use of osteopathic medical students from one osteopathic medical school located in the

southern part of the United States. This may limit the generalization of the study's results when compared to all first year osteopathic medical students and newly graduated osteopathic medical doctors entering the workforce. However, it is anticipated that the study could be replicated to other osteopathic and eventually allopathic medical students throughout the United States.

Another limitation of the study was that the study participants were surveyed during the same academic year. Both groups entered medical school around the same age and had similar MCAT scores. First year osteopathic medical students' MCAT scores were 28.12, while those of newly graduated osteopathic medical doctors entering the workforce were 28. The mean age difference of the newly graduated osteopathic medical students was 5.63 more than the entering medical students. The age difference was taken into consideration and adjusted. An ideal situation would have been to survey first year osteopathic medical students and then wait four years when they graduated and then survey the same group. In the interest of time to be able to complete the study, this was not practical.

Recommendations for Further Research

The results of the study provided ample opportunity to further research in the area of learning IT skills with a focus on preparing osteopathic medical doctors to enter the workforce. The survey tool developed for this study also provided a unique insight into how osteopathic medical doctors are learning IT skills while in medical school. More research is needed to provide further awareness in this area. Results of further research can help to provide benchmarks for learning IT skills. Further research might raise the issue about what non-health care related IT skills facilitate learning or enhancing IT

skills specific to the health care environment, such as EMR. Further research might expand on specific IT skills building exercises and the value of IT learning environments, such as the use of avatars for training. Age and gender are other areas for further research, along with why certain IT skills in health care are learned more readily by certain age groups, as well as the effect that gender has on learning. Another area of research is to study how practicing osteopathic medical doctors learn IT skills. According to Hassan (2006), IT skills outcomes are the primary issue for information systems research, and must be examined continuously to determine if there are significant differences in the IT skills of medical students due to the medical school experience. The exploration of a class that addresses IT skills in medical school may be necessary.

Summary

This research investigated the impact of the medical school experience on learning IT skills. According to Hersh and Williamson (2007), medical education primarily focuses on science and research, which may have limited opportunities, whereas medical informatics roles utilizing IT are on the rise. IT skills of first year students still are an unknown variable despite published literature on this subject (Palaigeorgiou et al. 2006). McEuen (2001) stated that "Fluency in IT is comparable to fluency in writing…all students come to college knowing how to write, but many students aren't developed writers" (p. 16).

A comprehensive literature search was performed to better understand learning and IT. From this literature research three areas emerged as major themes: information gathering skills, information analysis skills, and technology skills. The Learning Skills Profile was used as the foundation of the survey instrument. The survey instrument was

developed and then administered using surveymonkey.com. First year osteopathic medical students and newly graduated osteopathic medical doctors were asked to take this voluntary survey. Raw data was collected from the results of the completed surveys. The raw data was screened and then both groups were analyzed. These results were carefully reviewed both individually and then against each other for significant impacts on learning IT skills. The results were plotted either on charts or grafts. The results were interpreted as to their impact on learning IT skills.

Once the analysis was completed, the results were discussed as well as the conclusion. Next, the study's implications and limitations were reviewed and discussed. Future recommendations for research were presented in an effort to expand upon the body of knowledge that the results of this study presented.

The results of this study directly addressed the main research goal that was explored, which asks: What role does the osteopathic medical school experience and demographics have on learning IT skills? The results of the analysis of the data collected from the survey instrument graphically showed that the medical school experience did have an effect on learning IT skills, specifically IGS and IAS, while TS was not significant in preparing osteopathic medical doctors to enter the workforce. It is important to monitor the IT skills of osteopathic medical students to determine their weaknesses so that these deficiencies in IT skills can be addressed while preparing them to enter the workforce as competent osteopathic medical doctors.

Appendix A

IRB Approval Letter

NOVA SOUTHEASTERN UNIVERSITY
Office of Grants and Contracts
Institutional Review Board

MEMORANDUM

To: Steve Bronsburg
From: Ling Wang, Ph.D.
Institutional Review Board

Date: March 31, 2010

Re: *Comparing Information Technology Skills of Osteopathic Medical Students: A Case of Entering Verses Graduating Students*

IRB Approval Number: wang03151005

I have reviewed the above-referenced research protocol at the center level. Based on the information provided, I have determined that this study is exempt from further IRB review. You may proceed with your study as described to the IRB. As principal investigator, you must adhere to the following requirements:

1) CONSENT: If recruitment procedures include consent forms these must be obtained in such a manner that they are clearly understood by the subjects and the process affords subjects the opportunity to ask questions, obtain detailed answers from those directly involved in the research, and have sufficient time to consider their participation after they have been provided this information. The subjects must be given a copy of the signed consent document, and a copy must be placed in a secure file separate from de-identified participant information. Record of informed consent must be retained for a minimum of three years from the conclusion of the study.

2) ADVERSE REACTIONS: The principal investigator is required to notify the IRB chair and me (954-262-5369 and 954-262-2020 respectively) of any adverse reactions or unanticipated events that may develop as a result of this study. Reactions or events may include, but are not limited to, injury, depression as a result of participation in the study, life-threatening situation, death, or loss of confidentiality/anonymity of subject. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, number or types of subjects, consent forms, investigators, etc.) must be approved by the IRB prior to implementation. Please be advised that changes in a study may require further review depending on the nature of the change. Please contact me with any questions regarding amendments or changes to your study.

The NSU IRB is in compliance with the requirements for the protection of human subjects prescribed in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46) revised June 18, 1991.

Cc: Protocol File

Appendix B

Permission Letter to Survey Students

Main Identity

From: "Anthony Silvagni" <silvagni@nova.edu>
To: <bronsbur@nova.edu>
Cc: <levyy@nova.edu>; "Bart Whitehead, DMD, MEd. MBA" <walbert@nova.edu>; "'Goodwin, Johneta'" <johneta@nova.edu>; "'Lawrence Jacobson, DO'" <ljacobos@nova.edu>
Sent: Thursday, July 09, 2009 11:56 AM
Subject: FW: Thank You

I am happy you are progressing with your dissertation work, and that you are now approaching the data collection stage. As Dean of the Nova Southeastern University College of Medicine, I give you permission to administer a Web-based survey to our first and fourth year medical students after approval by the IRB and other appropriate NSU committees and/or offices. I look forward to seeing the finished dissertation and wish you the best as you move forward in your studies.

Anthony J. Silvagni, DO, PharmD, MS, FACOFP dist.
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NSU-COM Quality Enhancement Programs (QEP) Increasing Student Engagement in Academic Programs

A - Academical Societies
R - Research Fellowships
C - Clinical Education Programs

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Appendix C

Survey Instrument

All information on this form is voluntary and confidential.

Part A – Demographic Information:
1) Age___ 2) Gender_____ 3) MCAT Score_____
Part B - Survey: Please rate each item 1 to 7

		No skill or ability (1)	I am now learning this skill (2)	I can do this with some help or supervision (3)	I am competent performer in this area (4)	I am an outstanding performer in this area (5)	I am an exceptional performer in this area (6)	I am a creator or leader in this area (7)
	Information Gathering Skills							
IGS1	Being objective/viewing issues from many perspectives							
IGS2	Scanning and reading large amounts of information							
IGS3	Belonging to networks for sharing or receiving information							
IGS4	Listening with an open mind							
IGS5	Establishing relationships and information sources outside the organization							
IGS6	Being aware of issues in your organization							
	Information Analysis Skills							
IAS1	Staying on top of current knowledge in your field							
IAS2	Organizing and writing reports							
IAS3	Putting together information from different sources							
IAS4	Translating specialized information into practical, understandable reports							
IAS5	Organizing large amounts of information into meaningful patterns							
IAS6	Outlining the main points of an argument							
	Technology Skills							
TS1	Working with IT							
TS2	Operating high technology equipment							
TS3	Using IT networks and technical information sources							
TS4	Using IT for organizing and managing information							
TS5	Building IT models or simulators							
TS6	Using IT to analyze data							

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